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MUSCLE-READING AND THOUGHT-READING.

BY RICHARD A. PROCTOR.

IT appears to me that the subject of thought-reading, with many of its associated problems, promises to be interpreted successfully—up to a certain point—ere long. I say "up to a certain point," because experience shows that the solution of any given problem is never complete, but always brings with it other problems, and problems usually of greater difficulty. There can be no doubt that the whole subject of thought-reading is full of difficulty. Even the explanations which have been proffered by those who will admit nothing but trickery, recognise wonderful, one may say unheard-of, qualities. We are told, for example, that thought-reading is merely muscle-reading, and then that the muscle-reader can infer the shape, colour, place, and nature of an article which the muscle-*read* alone has in his thoughts; and this too without any consciousness on the part of the latter that he is thus conveying information. Anyone who has witnessed feats in so-called thought-reading, and noted the rapidity with which the results are obtained, will find this explanation not one whit less wonderful than the explanation according to which mind can influence (and be influenced by) mind, without any recognisable appeal to the senses. Of course there *are* wonders in muscle reading which of themselves are well worth studying as affording curious evidence of the range of varying capability among different persons. For instance, Professor Barrett relates a case of a young lady who could write words, or even rudely copy sketches which had been shown to her mother and not to herself, the mother sitting behind her and placing a finger on the girl's bare arm, above the flexed elbow. It was proved in this case that slight movements of the touching finger—movements certainly indiscernible and probably unconscious—conveyed a sufficient guidance to the girl's delicate skin and quick intelligence. Such cases as this suffice to show that the range of this muscle-reading power is marvellous—from the power of recognising emotion as expressed by hand-pressure to the power of writing words or delineating shapes from the suggestions of mere finger touch. Certainly a wonderful power or quality, this of muscle-reading; so wonderful that even in a case like this, where it is stated that the evidence was decisive, one would be disposed to doubt whether the experimenters, and the girl herself, were not in some way misled, seeing that thought-reading seems a simpler explanation than the idea of direct guidance. Let any two persons try the experiment; let one hold a pencil, and in response to the most anxious efforts of the other to guide him or her aright endeavour to write names or draw sketches of things not otherwise known, and the surprising nature of this explanation will, I think, be admitted. I am not myself wanting in sensitiveness or quickness to receive impressions. Nay, I am sometimes so quick to gather what is in the mind of others that I do not find the idea of thought-reading altogether incredible, even as measured by my own power; but I am sure that no amount of muscular indication, however carefully conveyed, would enable me to write the simplest word, or to draw the simplest outline, at the suggestion of another. When, therefore, Mr. Stuart Cumberland accomplishes feats, some of which are even more marvellous than those of the young lady just mentioned, and when he assures that it is all done by muscle-reading (such reading being sometimes conveyed along a wire or cord), I marvel much more than I would if he asserted, as others have done, that such feats are achieved through some power of thought-reading, which is as yet not understood even by those who possess it. I marvel so much, to say the truth, that I reject his explanation as inadequate, believing that he knows no more how he accomplishes his feats than those know who have witnessed them.

But there can be no doubt that other cases admit of no such explanation, similar results being obtained without contact of any sort, direct or indirect. There is a whole class of cases, for example, of which a case noted by that close observer, Charles Dickens, is the type. The man who exhibited the power in question was a professional conjuror, so that trickery and acquired quickness of perception and of action must have their fullest possible allowance. "He was with the company," says Dickens, "not in the least removed from them, and we occupied the front row. He brought in some writing paper with him as he entered, and a black-lead pencil; and he wrote some words on half-sheets of paper. One of these half sheets he folded into two, and gave to Mrs. Dickens to hold. 'Madame,' he says aloud, 'will you think of any class of objects?' 'I have done so.' 'Of what class, madame?' 'Animals.' 'Will you think of a particular animal, madame?' 'I have done so.' 'Of what animal?' 'The lion.' 'Will you think of another class of objects, madame?' 'I have done so.' 'Of what class?' 'Flowers.' 'The particular flower?' 'The rose.' 'Will you open the paper you hold in your hand?' She opened it, and there was neatly and plainly written in pencil: *The Lion, The Rose.* Nothing whatever led up to these words, and they were the most distant conceivable from Catherine's thoughts when she entered the room." Now, in this case, be it noticed, we have a keen observer, well acquainted with all the ways and devices of conjurors, writing, immediately after the event, an account not intended for publication: we are entitled to assume that matters befel as they were here described. Again, the case is not one of thought-reading by the performer, but clearly of thought-guiding: in other words, Mrs. Dickens unconsciously read the thoughts of the man, and took them for her own. That there was thought-reading in this case, *somewhere*, is certain, unless we adopt the idea that Mrs.

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Dickens was in league with the performer to deceive her husband with the rest of the company present.

The great difficulty in all such cases has been that the person whose mind is influenced, the thought reader, has been unconscious of the influence. Certain ideas present themselves, but why or whence is unknown. The idea must, one would say, have been received consciously; it is at any rate recognised consciously after reception; but there is no conscious recognition of its communication. Now if two minds or consciousnesses, in the same person, are at work in such cases, the difficulty is to some degree removed. Suppose one consciousness (being in that state recognised in somnambulism when other influences than those ordinarily at work affect the mind) receives an impression from the thoughts of others, and that the idea is transmitted to the other consciousness, alone consciously active, in the same way that impressions received during the somnambulistic state affect the wakened consciousness, then the observed phenomena can be in a sense understood. Only "in a sense," for no one has yet explained the mysterious sensitiveness of the somnambulist, or how it is that while memory retains no active consciousness of events which had happened in the somnambulistic state, those events exert a vague influence and excite unexplained emotions after that state has passed away.

We may certainly see reason for seeking in this direction the explanation of some of those phenomena attributed to so-called spiritualism. Many have been perplexed because persons whom they shrewdly suspect to be rogues and charlatans—nay, may even know to be so—seem to convey to them, in writing or otherwise, such messages from the dead as could not have been forged without some knowledge as they themselves alone possess. But, in reality, such messages would seem to come in all cases either directly or indirectly from themselves. The first and only time my wife ever wrote with the planchette, for example, she found the instrument on which her fingers and those of a friend rested starting off to write about what she was thinking of (her friend not *consciously* knowing what my wife's thoughts were). She herself and her friend left the planchette alone forthwith—they were both girls at the time—imagining there must be something uncanny about it; and very naturally. But my wife's second consciousness, the mind and will belonging to the ordinarily inactive half of the cerebrum, may quite actively have directed the planchette's career, and quite unconsciously to herself. There would be no greater mystery in this than in the complete unconsciousness of the awakened somnambulist as to the actions, ideas, and emotions by which, while in the somnambulistic state, he had been strongly moved. Now, if a medium, charlatan though he may presumbly be, has the power of reading minds in the hypnotic state (whether his own mind be in that state or not), he can make such answers or communications respecting the dead, either by planchette writing or otherwise, as would seem to the inquirer to contain proof positive of knowledge communicated by the spirits, or in some other miraculous manner; yet he would really have presented only the thoughts of the inquirer's other self. It certainly corresponds with this view, that nothing which has not been known either to the inquirer or the medium has ever been communicated in this way.

One of the oddest cases of deception in this matter of supposed communications from the dead came under my notice a few months ago in Washington. A slate on which a neatly-written communication from his wife, many years deceased, had been produced by alleged spirit agency, was shown me by her husband. The writing was his wife's, and the medium could not have known her writing; it was, however, rather better writing than hers had been, wherefore it was comforting to be informed (as he was by the deceased lady herself) that the handwriting improves in the spirit world! He received also a neatly written communication from a child of his who had died at the age of six months! The medium had not known this, by the way, or perhaps the result might have been different. The communication from a dead baby was remarkable for the length of the words and the singularly business-like tone of the message. However, in the case of the wife, the communication would have been remarkable, were it not interpreted as the product in reality of the man's own mind. Of course, it was written by the medium; but by a clever bit of legerdemain the slate with the communication neatly written upon it was substituted (as any fifth-rate conjuror could easily manage) for another which had been carefully cleaned. The belief of the medium's victim, that a tiny bit of slate-pencil shut up in the folding-slate, and so left, while the slate was beside him, had done all the writing in response to the medium's spiritual influence, was touching in its innocence.—*Newcastle Weekly Chronicle.*

THE PHILOSOPHY OF CLOTHING.

By W. Mattieu Williams.

IX.—GASEOUS CLOTHING MATERIAL.

In my last I showed how Rumford's experiments lead to the conclusion that the resistance of air to the passage of heat through it is the primary fact upon which the efficiency of our clothing in retaining our bodily heat depends, and that the function of the fibres is to imprison between them a statum of air which cannot freely circulate and carry away the heat by convection.

The same applies to the fur and feathers of nature-clad animals. The land mammalia generally have more hair on their backs than on their breasts and bellies. The opposite is the case with man. "Man's bare back" has been frequently cited as an enigma that puzzles the modern evolutionist. This conundrum was very fairly answered long ago by Rumford in his eighth essay on "The Propagation of Heat in Various Substances." He there tells us that "Bears, wolves, foxes, hares, and other like quadrupeds, inhabitants of cold countries, which do not often take the water, have their fur much thicker on their backs than upon their bellies. Heated air occupying the interstices of the hairs of the animal tending naturally *to rise upwards*, in consequence of its increased elasticity, would escape with much greater ease from the backs of the quadrupeds than from their bellies had not Providence wisely guarded against this evil by increasing the obstructions in those parts which entangle it and confine it to the body of the animal." I may add to this that the part of man which corresponds in physical position to the backs of animals—viz., the top of his head—is protected by the greatest abundance of hair, and that his eyes are protected from the blinding effect of the sweat drops which roll down the forehead, when he works heartily, by the eyebrows and eyelashes; the whiskers have a similar function, their absence in women being consistent with their general unfitness for severe physical labour.

There is a further action of hair and feathers in impeding the circulation of the air entangled among them which is less obvious, and which our modern physiologists appear to have quite overlooked, though Rumford pointed it out very distinctly. This is the adhesion of air to the surface

of hair, feathers, and other solids, or, as he calls it, "the attraction which subsists between air and the bodies above-mentioned, and other like substances constituting natural and artificial clothing." He describes this as a necessary supplement to the mere mechanical entanglement of otherwise freely moving air.

That such an attraction, and a very strong one, subsists between air and the clothing material appears, as Rumford says, "by the obstinacy with which these substances retain the air which adheres to them, even when immersed in water, and put under the receiver of an air-pump; and that this attraction is essential to the warmth of these bodies, I think, is very easy to be demonstrated."

His demonstration is that the attraction between the particles of air and the surface of the hairs, feathers, &c., "being greater than the increased elasticity, or repulsion of those particles with regard to each other, arising from the heat communicated to them by the animal body, the air in the fur, though heated, is not easily displaced; and this coat of confined air is the real barrier which defends the animal from external cold. This air cannot *carry off* the heat of the animal, because it is itself confined by its attraction to the hair or fur; and it transmits it with great difficulty, if it transmits it at all, as has been abundantly shown by the foregoing experiments."

The running of water off a duck's back has become proverbial, and everybody knows that these and other aquatic birds are not wetted by the water in which they swim. It is commonly believed that these animals oil their feathers, and I have read accounts of special oil-glands with which the animal is said to be supplied, and by means of which it oils its feathers in order to keep the water from wetting them; but the writers do not provide any paint brush for the purpose, with a handle sufficiently long and curved to reach all over the back, neck, &c., every part of which in this and all other aquatic birds being equally waterproof. As this idea of feather-oiling has considerable popular extension, and even some amount of learned pretension, and as the subject has all the importance which Rumford claimed for it in reference to the philosophy of clothing I will explain it further.

Let the reader take a few iron filings and sprinkle them on the surface of some water in a tumbler. If he has not already made the experiment, he will be rather surprised to find that, instead of sinking, as iron should, according to its specific gravity, they will float. Let him persevere, sprinkling gradually more and more. Ultimately the lower stratum will be borne down by those above, and they will all sink, forming a curious agglomeration at the bottom of the tumbler. Leave them for a while, and then pour off the water as completely as possible and examine the filings. They will be found quite dry, in spite of their immersion. Repeat the experiment, and observe carefully all that occurs. It will be seen that the sinking agglomeration consists of iron filings in a sort of air-balloon, the bulk of the air far exceeding that of the filings.

Now take a little of the calcined magnesia that is sold by the druggists, selecting for this experiment the lighter form, which is a powder so fine that when blown as dust into the air it falls very slowly. Sprinkle this on the water, and the paradox of the light powder sinking while the heavy metal floats will be demonstrated. If a suitable sample of magnesia is used, it will sink more rapidly in water than it falls through air, and you may ask your mathematical friends to reconcile this with their formulated theories of "viscosity" and "shearing force."

Another experiment, one which I devised many years ago for illustrating this subject, may now be tried. Take a piece of white card, and hold one side over the upper part of the flame of a candle or lamp until it becomes coated with a thin sooty deposit. When this has cooled dip the card edgewise in a tumbler, or other glass vessel, of water, and observe the result. First look at both sides of the card perpendicularly to its faces. Thus seen, one side appears black the other white, as they appeared before immersion. Now look obliquely, and a wonderful difference will be observed. The white side remains as before, but the black surface appears like a plate of burnished silver. Remove the card from the water, and its black side will be found quite dry, the white side freely wetted.

Sprinkle some water lightly on both sides of the card. That which falls on the white side will adhere, that on the black side will roll about in little spheres like drops of quicksilver, or like corresponding sprinklings of water on the duck's back.

These results depend upon the fact that the iron and the carbon condense upon their sufaces a film of air which adheres with a force exceeding that which tends to float it. In the case of the floating iron, the quantity of air required to effect the buoyancy must exceed six and a half times the bulk of the iron, the specific gravity of iron being seven and a half times that of water. The silver-like brilliancy of the film of air upon the carbon deposit is due to that total reflection which occurs whenever light cannot be transmitted without perpetrating a mathematical inconsistency. When a ray of light passes from a dense to a rarer medium, or *vice versâ*, it is bent or refracted in such a manner that for given media the sine of the angle of its emergence bears a fixed ratio to that of incidence. When the obliquity of incidence exceeds a certain amount, the observance of this ratio becomes impossible, and the light, rather than mathematically stultify itself, refuses to pass through at all, turns back altogether. Students of optics understand this, and I must not be refracted from my present path by further explanation of it, though I may be allowed to add that it affords a most elegant physical demonstration of the perfect inflexibility of a natural law. All natural laws, *when truly expounded*, are equally free from exception.

Many aquatic animals are so effectively clothed with adhering air that they carry with them under the water a little atmosphere of their own, and this atmosphere is rendered beautifully visible to the student by means of the total reflection above described. The water-beetles may be named as examples. Some of them may be seen under water reflecting the sunlight by means of their ærial envelope, which appears like an animated globule of quicksilver. The water-spider (one of the most interesting inhabitants of a small fresh water aquarium) displays this very beautifully. He is covered with hairs to which the air adheres so firmly that he lives under water in the midst of a reservoir of air of such dimensions as to supply him a good store of respiratory gas. When he has exhausted the oxygen of this cargo of air he comes to the surface, where the bubble instantly bursts, its nitrogen and carbonic acid are diffused away, and a new supply of breathable air takes their place, with which supply its proprietor descends again.

In some of our public aquaria there are diving birds which afford an interesting opportunity of studying this atmospheric envelope. They may be seen under water enveloped in a shining gaseous coat of mail, and the absolute opacity of air when viewed obliquely through water is further demonstrated by the appearance of their immersed legs and bellies while swimming, and the utter invisibility of all that is above the surface of the water to the spectator who is looking upwards obliquely through the glass and the water. In the absence of an aquarium, take a tumbler

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of water, hold it above eye level, look through the side to the water surface. The air that rests upon it appears like burnished silver, and its opacity is proved by holding the finger or any other object just above the water surface, then dipping it in the water. This simple experiment is very instructive.

In my next I will endeavour to supply a proximate idea of the quantity of air that may possibly be held captive by clothing materials.

NOBERT'S RULING MACHINE.*

BY JOHN MAYALL, JUN., F.R.M.S., F.Z.S.

(*Continued from p.* 433.)

ABOUT the year 1823 a great improvement in the construction of compound refracting microscopes was initiated by Selligues,† who applied achromatism to the objectives, by which, in the course of a few years, the instrument was so much advanced that there was considerable difficulty in discovering test-objects of a nature suitable to serve as standards for estimating the quality of the newer objectives, and especially for testing the value of each increase of aperture as successively attained.

Herr Nobert appears early in life to have been interested in the progress of the construction of the achromatic refracting microscope. The difficulty attending the testing of the increased apertures, doubtless, led him to devote his attention to the production of fine rulings, whilst the publication of Frauenhofer's experiments with diffraction gratings would likewise stimulate him to improve upon the results obtained with Frauenhofer's rulings, both in the direction of fineness and accuracy.

For some time previous to 1845. Herr Nobert, then resident in Greifswald, appears to have been engaged in designing and constructing the ruling machine which I here exhibit, for in that year he succeeded in ruling a test-plate with ten bands of lines, which, commencing with $\frac{1}{1000}$th of a Paris line, and continuing in geometrical progression, ended with lines of $\frac{1}{4000}$th of a Paris line (from $\frac{1}{11261}$ to $\frac{1}{45045}$ of an English inch). You will observe that Nobert's coarsest lines ranged somewhat finer than the finest of the set of micrometer-plates I have referred to as representing the fine rulings before the days of the achromatic refracting microscope. Each band ruled by Nobert consisted of a number of parallel and equidistant lines at the rate specified, and a blank space, about equal in breadth to the bands, separated the successive bands. These bands of lines were intended as test-objects, to determine the resolving power of microscope-objectives. Herr Nobert mentions (in a MSS. published after his death, but evidently written about 1861) that "the German microscopes of that dates resolved the 8th band of that plate, and Amici's the 9th, whilst in the following years, when the plate had become known in England, the decided superiority of English instruments resolved all ten bands."

The immediate effect of Nobert's rulings was to reverse the order of things that had hitherto obtained in microscopy. Before the issue of his test-plate, opticians and microscopists hardly knew where to seek for an object capable of severely testing the resolving power of their newer objectives with increased apertures. But now, at one bound, he went beyond the resolving power of the finest microscopes of the day. And, strange as it may seem, so far reaching was Nobert's mechanical genius, that the machine of 1845 not only enabled him to produce rulings finer and finer, always beyond the resolving power of the most perfect objectives as successively brought out by the contemporary opticians; but when, in 1869, after most ardent devotion to the task, the eminent microscopist, the late Dr. J. J. Woodward, of the Army Medical Museum, Washington, succeeded in photographing the highest band of the 19-band plate ($\frac{1}{100000}$th of a Paris line$=\frac{1}{112613}$ of an English inch, with Powell and Lealand's water-immersion $\frac{1}{16}$th objective, Nobert immediately outstripped all his previous efforts by ruling a plate with lines twice as fine—that is to say, ranging from $\frac{1}{1000}$th to $\frac{1}{20000}$th of a Paris line (from $\frac{1}{11261}$ to $\frac{1}{225224}$ of an English inch). This last plate was rather a *tour de force*, and will tax the resolving power of the microscopes of the future.

By the courtesy of the Surgeon-General of the United States Army I have received the series of Dr. Woodward's photo-micrographs of Nobert's 19-band plate, and they are here for your inspection.

But I must go back again briefly to earlier dates. About 1850, Mr. Warren De la Rue* made an elaborate series of trials with Nobert's lines, and induced him to add bands of finer lines to his test-plates, so that gradully he arrived at a plate containing 30 bands, beginning at $\frac{1}{1000}$th and reaching $\frac{1}{30000}$th of a Paris line ($=\frac{1}{300090}$th of an English inch). In 1860, Messrs. Sullivant & Wormley† succeeded in counting the lines in the 30th band, whereupon Nobert, wishing to add still finer lines, and yet to diminish the labour of ruling so many bands, recast the fractional divisions of the successive bands, still keeping to the Paris line as the unit, resulting in the 19-band plate to which I have already referred. When Dr. Woodward succeeded in photographing and counting all the lines on the 19-band plate, thus furnishing a perfect demonstration that the development of the resolving power of the microscope had unquestionably reached the level of the 19-band plate, Nobert again re-cast the fractional divisions of the successive bands, resulting in the latest 20-band plate ranging from $\frac{1}{1000}$th to $\frac{1}{20000}$ of a Paris line. Regarding this plate, I may remark that Dr. Woodward did not succeed in photographing any lines beyond the 19th band, which was precisely equivalent to the 19th of the 10-band plate. I take this opportunity, however, of stating that Mr. E. M. Nelson, so well-known for his manipulative skill with the microscope, has succeeded in resolving the eleventh band ($=\frac{1}{11000}$ of a Paris line$=\frac{1}{123873}$ of an English inch), using the oxy-hydrogen lamp for the illumination in my presence.

You will understand, then, that Herr Nobert devised these fine rulings to serve as test-objects for the resolving power of microscope-objectives. On the supposition that an objective had a given extent of aperture free from aberration, then, according to a certain optical formula, suggested by Frauenhofer, such an objective should resolve consecutive lines of a certain degree of closeness. The bands of lines were graduated in fineness by Nobert, with a view to furnishing an approximately exact measure of the limit of the resolving power of any objective tested upon them. In recent years Frauenhofer's formula has been revised by Helmholtz and Abbe (independently), so that the theoretical limit of resolution has been extended two-fold for every increment of aperture, on the supposition that light of the greatest possible obliquity is employed for the illumination.

* From the *Journal of the Society of Arts*. A paper read before the Society on May 6.

† Quekett's "Treatise on the Microscope," third edition (1855), p. 40.

* Queckett's "Treatise on the Microscope," third edition (1855), pp. 511-4.

† "American Journal of Sciences and Arts," Jan., 1861.

I remark, *en passant*, that the mere resolution of a specially high band seems to have been erroneously regarded by Herr Nobert and others as a sufficient test of the quality of an objective; whereas it can be demonstrated that the fact alone that an objective resolves a given band proves only that the particular zone of aperture which is utilised in such resolution is free from aberration; and this may obtain in an objective in which nearly the whole of the other portion of the aperture is so affected by aberration that the objective, as a whole, must be regarded as of inferior quality.

With reference to the interference plates and diffraction gratings ruled by Herr Nobert, I cannot speak from personal experience with them. He claimed for them that they were the real tests of the accuracy of his ruling machine, as regards exact equidistance of the divisions, parallelism of the lines, equality in thickness, and symmetry of angles of the actual rulings; and as he had to face many sceptical critics, I think it may fairly be assumed that his claims were admitted, inasmuch as they were not refuted. I shall have to direct your attention to the special means employed by Herr Nobert to secure the strict equidistance of the divisions required for the diffraction gratings, where lines of one Paris inch in length were ruled over a breadth of one Paris inch, at the rate of 1,200 to 12,000 to the Paris inch—that is to say, the whole space was covered by lines of these degrees of fineness. He states that "these gratings show spectra of such perfection, that in the wave-lengths of the Frauenhofer lines, as established by Prof. Listing, even the $\frac{1}{10000000}$ of a millimètre is made apparent;" and that the absolute measure of his divisions was "founded on a standard accurately corresponding with the original Bessel standard-measure made by the distinguished Berlin mechanician, Baumann."

Herr Nobert appears formerly to have held that Frauenhofer's formula based on the constitution of light (to which I have alluded) would present an absolute bar to the resolution of lines finer than $\frac{1}{8000}$ of a Paris line ($\frac{1}{90000}$ to the English inch); Dr. Woodward's photographs, however, disproved this theory to his complete satisfaction. A suggestion was also made by an adverse critic, that possibly the higher bands, which had not been resolved, did not really contain the lines alleged by Nobert; to which Nobert answered by providing an interference-plate * which "proved indirectly ($= \frac{1}{8000}$th of a Paris line $= \frac{1}{90000}$th of an English inch) the existence of all the lines up to 0'''·000125 by the spectra they showed. With this plate was also proved, empirically, the inference from the undulatory theory of the disappearance of the colours, when the distance of the lines is less than the smallest wave-length in the medium used."

(To be continued.)

THE YOUNG ELECTRICIAN.

By W. Slingo.

(*Continued from p. 407.*)

WOOD-BORING TOOLS.

EX. LVII.—The young electrician will do well to have always by him a few gimlets and bradawls of various sizes. They are too well-known to require any description. It may, however, be observed that when he desires to bore a relatively large hole, and is restricted to gimlets, it is best to first make a small hole, and increase it by subsequently introducing a larger tool. Otherwise there will be considerable risk of splitting the wood. The fact that gimlets taper towards the point increases the risk of splitting, more especially in the case of soft wood.

A bradawl is not, in the true sense of the word, a boring-tool, as it simply squeezes the wood away as it enters. Nor is a gimblet very much better; it certainly removes some of the wood, but a great portion of its work consists also in squeezing. A gimblet is only a cutting-tool in a very limited sense; more frequently it *tears* the wood away—a fact which is often responsible for the splitting of the wood.

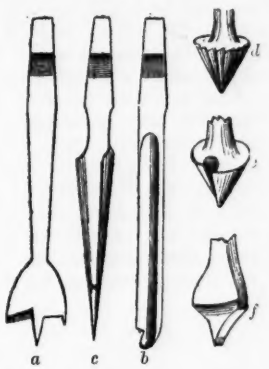

Fig. 30.

Ex. LVIII.—To turn to tools which cut at the same time they bore a hole, Fig. 30 illustrates a few forms of what are known as bits.

The most frequently used are those lettered *a* and *b*, the former being called a centrebit, and the latter a spoonbit. They are, of course, made in a great number of sizes, suitable for as many different sized holes.

The centrebit has usually a long square shank, the lower portion being flattened out approximately to the shape shown, the extremity taking the form of a point, which lies in the axis of rotation. On the left side (of the drawing) is the cutting edge, which consists of a small portion of the metal bent forward and thinned into a species of knife edge. On the other side, at a distance from the centre equal to that of the remote extremity of the cutting edge, is a sharp and pointed prong, the metal between it and the centreing-point being well cut away. The function of the prong is to assist in maintaining the position of the tool. A hole cut by the centrebit should be parallel throughout, and straight.

The spoonbit differs from the centrebit in that the cutting edge is vertical. In section it partakes of a semi-circular form, the radius from which the inner side is struck being, however, smaller than that of the outer. The end of the tool is rounded. For long holes, which are required to be cut straight, the spoonbit is preferable to that previously described, on account of parallelism existing between the sides or edges of the bit and the hole so far as it is bored.

A bit of a character similar to that of the spoonbit, but less frequently used, is that known as the rimer or taper-bit. The illustration (Fig. 30*c*) explains its shape sufficiently well to obviate the necessity of any further description. The tool is used for cutting a taper hole or opening out a hole in thin material (where the use of either of the other bits would probably result in spoiling the board).

When screws are used in the wood, it is in most cases

* Poggendorff's "Annalen," lxxxv., p. 83.

customary to make the head of the screw flush with the work. This is done by countersinking.

Fig. 30*d*, illustrates the form of tool mostly used, it is known as the rose countersink. It is made by forming a series of cutting edges on a conical piece of steel of the same angle as the head of the screw, which is to be driven into the hole.

Fig. 30*e* illustrates another and almost equally good form, called the shell countersink, which consists of a conical piece of steel with a single cutting edge, produced by boring a hole down the length of the cone, and thereby removing a small section of the cone's face.

A common form used for rough work is that known as the drill countersink (Fig. 30*f*). It is a modification of the simple drill. The disadvantage of this tool is that with soft wood one cannot ensure a perfect countersink, but will more probably obtain only a succession of ridges.

It may be observed that these countersinking bits, although mentioned with reference to woodwork, are also applicable to metals, oil being used for lubricating purposes in the case of iron, &c. (Ex. XXXVI*f*).

Ex. LIX.—As with drills, so with bits, a stock or brace is necessary for the purpose of rotating the tool. Fig. 31 illustrates a cheap and, at the same time, quite efficient form. A curved iron bar, B C A, is rotated in a

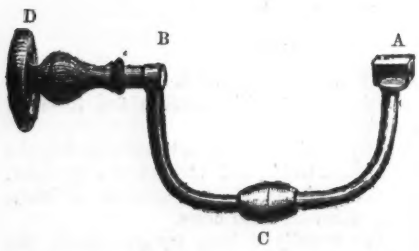

Fig. 31.

Fig. 32.

socket at the extremity of a wooden handle, D, and is provided at A with a holder for the bits. This holder consists of a square piece of iron, with a tapered square hole passing through it, and a thumbscrew passing through one side of the square. It will be observed that the bits (Fig. 30) are each provided with a notch near the upper end. Into this the screw of the holder (A, Fig. 31) is turned, the bit being thereby held securely in the stock. In other and more expensive forms there is a spring instead of a screw for holding the bit in place. The rotation is produced by pressing on D and turning the handle C.

Ex. LX.—In Fig. 32 is depicted another form of brace, which is, however, relatively expensive. Its primary features are the same as those of the less elaborately finished article (Fig. 31). The points of difference are in the means provided for holding the bits, and the introduction of a ratchet arrangement. The ratchet is a device for enabling one to bore holes in a corner or in any other similar position in which the rotation of the stock is impracticable. The holder is adjustable to suit the various sizes of bit-shanks, which are secured by screwing down the collar or casing forming the outside of the holder.

MEASURING INSTRUMENTS.

Simple measuring instruments, such as the rule, are to be found in most households, whence a reference to what may be regarded as one of the most important class of tools has been thought up till now in a measure unnecessary. It is essential, however, that a little attention should now be bestowed upon them. As a matter of fact there is no one warning so important or fraught with such dire consequences if neglected as that enforcing the necessity for the strictest possible attention to measurement and fit. A neglect of this kind will often produce a failure where good workmanship in other directions warranted the anticipation of success.

Ex. LXI.—For measuring straight lines rules answer best. Tapes are used by surveyors, but they are inaccurate when the measurements are small. There are several forms of rules, but perhaps the best is the steel 12-inch rule, which is marked with English and French measurements. Although some boxwood rules are also so marked, it is noteworthy that the edges of a steel rule are made sufficiently straight to permit of its use as a straight-edge. A second purpose is thus answered by the one tool, and no advantage is gained by unnecessarily multiplying the number of tools.

Ex. LXII.—An instrument is necessary for describing circles. With wood a pair of ordinary compasses may be used, but with metal a form of compass known as the spring divider is most usually employed. It has an adjustable leg and the points are fine and made of hardened steel. As a tool it is cheap and should not, therefore, be dispensed with.

Ex. LXIII.—Means for measuring the internal and external diameters of cylinders must be procured. Such tools are known as callipers. Fig. 33 furnishes a good idea of the form of calliper used for measuring the external

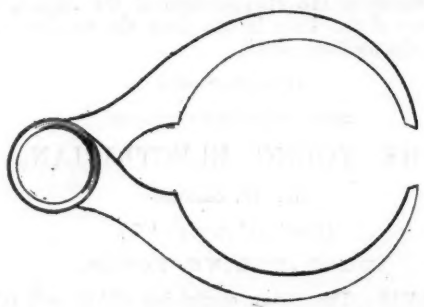

Fig. 33.

diameters. It consists of two pieces of steel cut to the shape shown and hinged together so as to allow the distance between the points to be increased or decreased at will. To measure with this tool, the points are opened until they pass accurately over the cylinder, rod, &c., that

is to say they must both touch the work, and yet pass without being forced. The distance between the points, measured on a rule, gives, of course, the size of the work. The tool is manifestly useful for ascertaining the thickness of a plate, block, &c.

Ex. LXIV.—For taking inside measurements, the form of calliper employed is that shown in Fig. 34, which consists of two legs of flat steel cut to the shape indicated and hinged at their thicker ends. Measurements are made by causing the points which protrude outwards to pass into the hole, &c., just, but quite, touching the opposite sides. The distance between the points indicate, as before, the dimensions sought.

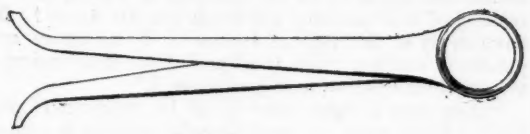

Fig. 34.

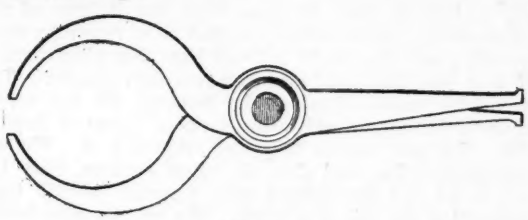

Fig. 35.

Ex. LXV.—A form of calliper sometimes, but not largely, used is the compound type illustrated in Fig. 35. It embodies the features of the tools for external and internal measurement. The drawing explains itself. One advantage claimed for this form is that both ends indicate, at the same moment, the same measurement. But this advantage is a very questionable one. It is apparent that a tool which is frequently used is more likely to wear than one which is not used so much. Now, external callipers are much more frequently requisitioned than internal ones, whence our compound callipers stand a good chance of being worn much more rapidly at the end A than at the end B. When that takes place the indications of the two ends are no longer identical.

Ex. LXVI.—There are a few other tools which will be required occasionally, such as a square, T-square, plane, saw, &c., but they are so well known and so often used that nothing further need be said about them.

* * * * *

I think I may now fairly suppose that our young electrician is sufficiently well equipped with tools to enable him to make a good start with the study of experimental electricity, and I shall therefore turn his attention next to the experiments themselves, and I trust that he will find in them a source of knowledge of a character which will set him thinking and interest him in the deductive branches of the science. I do not, as I said at the commencement of this series, purpose dilating upon theories. I intend rather to simply enunciate such laws and principles as are more generally accepted as being correct, and then to set before the young electrician such experimental demonstrations as he may be able to repeat, and so make himself master of the subject. I shall be greatly disappointed if it turns out that he does not learn to regard electricity as a subject full of interest, full of attraction, and yet as a science whose possible applications we so far know little about. If, in the course of half a century it is possible to initiate and bring to its present state of (relative) perfection the electric telegraph, to startle the world with the telephone, and to illuminate its dark places with the electric light, what, in fair reason, ought the immensity of the future to bestow upon posterity?

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

BY MONS. DE FONTENELLE.

WITH NOTES BY RICHARD A. PROCTOR.

THE SIXTH EVENING (*continued from p. 411*).

"FOR my part," says I, "I am such a foe to a perfect equality, that I cannot even allow all the turns which the earth every day makes on herself should be precisely in twenty-four hours, and always equal one to another; I should be very much inclined to think that there are variations."

"Variations!" cried the lady; "why, do not our pendulums mark an entire equality?"

"O," says I, "to your pendulums I must object, for they cannot be altogether just; and sometimes when they are, in showing us that one circuit of twenty-four hours is longer or shorter than another, we should rather be inclined to believe them irregular than to suspect the earth of any irregularity in her revolutions. What a complaisant respect is this we have for her! I would no more depend on the earth than on a pendulum; and the very same casualties almost which will disorder the one, will make the other irregular! Only, I believe there must be more time allowed for the earth, than a pendulum, to be visibly put out of order; and that is all the advantage we can give on her side. But might she not by degrees draw nearer to the sun? And there finding herself in a situation, where the matter is more agitated, and the motion more rapid, she will in less time make her double revolution both about the sun and herself; so consequently her years and days will be much shortened, but not to be perceived, because we must still go on to divide the year into three hundred and sixty-five days, and the day into twenty-four hours: so that without living longer than we now do, we shall live more years; and on the other hand, as the earth withdraws from the sun, we shall live fewer years than we do now, and yet have our lives of the same extent."

"There is a great deal of probability," says she, "that whenever it falls out thus, long successions of ages will make but very little variation."

"I agree with you, madam," replied I, "the conduct of nature is very nice, and she has a method of bringing about all things by degrees, which are not sensible, but in very obvious and easy changes. We are scarce able to perceive the change of the seasons, and for some others which are made with a certain deliberation, they do not fail to escape our observance. However, all is in a perpetual rotation, and not so much as the lady's face in the moon, which was discovered with telescopes, within these forty years, but what is grown considerably old. She had a good tolerable countenance, but now her cheeks are sunk, her nose grown long, and her chin and forehead meet, so that all graces are vanished, and age has made her a terrible spectacle."

"What a story do you tell," says the lady, interrupting me.

"It is no imposition, madam," replied I, "they have perceived in the moon a particular figure, which had the air of a woman's head jutting out of rocks, and it is owing to some changes that have happened there. Some pieces of mountains have mouldered away, and left us to discover three points, which can only serve to make up the forehead, nose, and chin of an old woman."

"Well," says she, "but do not you think it is some destiny that had a particular spite to beauty? And very justly it was this female-head, which she would attack above all the moon."

"Perhaps in recompence," replied I, "the changes which happen upon our earth, dress out some face, which the people in the moon see; I mean something like what we conceive a face in the moon; for every one bestows on objects those ideas of which they themselves are full. Our astronomers see on the surface of the moon, the faces of women, and may be, if the ladies were to make their speculations, they would discern the physiognomy of fine men. For my part, Madam, I do not know whether I should not fancy your ladyship's charms there."

"I protest," says she. "I cannot help being obliged to any one who should find me there. But to come back to what you were mentioning just now: do any considerable changes affect the earth?"

"In all appearance they do," replied I. "Old fables tell us that Hercules split asunder with his hands the two mountains called Calpe and Abila, which stand betwixt Afric and Spain, stopped the ocean from flowing there, and that immediately the sea rushed with violence over the land, and made that great gulph which we call the Mediterranean. Now this is not only fabulous, but a history of those remote times, which has been disguised, either from the ignorance of the people, or thro' the love they had for the marvellous, the most ancient frailties of mankind. That Hercules should separate two mountains with his two hands, is absolutely incredible; but that in the time of one Hercules, or other, for there were fifty of that name, the ocean should force down two mountains, not so strong as others in the world, perhaps thro' the assistance of some earthquake, and so take his course betwixt Europe and Afric, gives me no pain to believe. What a notable spot might the lunar-inhabitants all of a sudden discover on our earth; for you know, Madam, that seas are spots. It is no less than the common opinion, that Sicily was separated from Italy, and Cyprus from Syria. There are sometimes new islands formed in the seas; earthquakes have swallowed up mountains, others have rose and altered the course of the planets. The philosophers give us apprehensions that the kingdoms of Naples and Sicily, which are countries founded upon great subterranean vaults, full of sulphur, which will one day sink in, when those vaults shall no longer be able to resist the flames which they contain, and at this time exhale at those vent-holes, the mouths of Vesuvius and Ætna. Is not here enough to diversify the sight which we give to the people in the moon?"

"I had much rather," says the Marchioness, "that we had disgusted them with the same object always than diverted them with the swallowing up of provinces."

"I do not know," replied I, "if within this little time there have not been several burnt up in Jupiter."

"What, provinces burnt up in Jupiter!" cries she, "upon my word, that would be considerable news."

"Very considerable," says I, "madam. We have remarked these 20 years in Jupiter a long trail of light more glaring than the rest of that planet's body. We have, here, had deluges, perhaps they may have suffered great conflagrations in Jupiter. How do we know to the contrary? Jupiter is 900 times* bigger than the earth, and turns on his own center in 10 hours, whereas we do not turn in less than 24, which implies that his motion is 216 times stronger than ours. May it not be possible that, in so rapid a circulation, its most dry and combustible parts should take fire, as we see the axle-trees in wheels, from the rapidity of their motions, will break out into flames? But however it is, this light of Jupiter is by no means comparable to another, which in all probability is as ancient as the world, and yet we have never seen it."

"How does a light order it to be concealed?" says she. "There must be some singular address to compass that point."

"This light" [the zodiacal], replied I, "never appears but at twilight, which is often strong enough to drown it; and even when twilight suffers it to appear, either the vapours of the horizon rob us of it, or it is so very faint, and hardly to be perceived, that for want of exactness in our knowledge, we mistake it for the twilight. But, in short, they have of late years with much certainty distinguished it; and it has been for some time the delight of the astronomers, whose curiosity wanted to be roused by some novelty; and they could not well have been more touched if they had discovered some new secondary planets. The two latter moons of saturn, for instance, did not ravish them to that degree which the guards or moons of Jupiter did. But now we are fully accumstomed to it. We see, one month before, and after, the vernal equinox, when the sun is set and the twilight over, a certain whitish light resembling the tail of a comet. We see the same before sunrise, and before the twilight, towards the autumnal equinox; and towards the winter solstice we see it night and morning, except at these times it cannot, as I but now observed, disengage itself from the twilights, which are too strong and lasting; for we suppose it to be a continued light, and, in all probability, it is so. We have begun to conjecture that it is produced from some prodigious quantity of matter crowded together, which circles round the sun to a certain extent. The greatest part of his rays pierce through this gross circuit, and come down to us in a right line; but some, resting on the inner surface of this matter, are from thence reflected to us, and come with the direct rays, or else we cannot have them either morning or evening. Now, as these reflected rays are shot from a greater height than those which are direct, we must, consequently, have them sooner, and keep them longer. On this foot I must acquiesce in what I have already mentioned, that the moon must have no twilight for want of being surrounded by such a gross air as the earth. But she can be no loser; her twilights will proceed from that kind of gross air which surrounds the sun, and reflects his rays on places which his direct one cannot reach."

"But pray let me know," says the Marchioness, "are not there twilights settled for all the planets, who will not need every one to be clothed with a distinct gross air, because that which surrounds the sun alone, may have one general effect for all the planets in the vortex? I am mighty willing to think Dame Nature, agreeable to that inclination which I know she has to oeconomy, and good management, should make that single means answer her purpose."

"Yet," replied I, "notwithstanding this supposed oeconomy, she must have, with respect to our earth, two causes for twilight; one whereof, which is the thick air

* 1,200 times would have been nearer the mark.—R.P.

about the sun, will be wholly useless, and can only be an object of curiosity for the students of the Observatory; but not to conceal any thing, it is possible that only the earth sends out from herself vapours and exhalations gross enough to produce twilights, and that Nature had reason to provide, by one general means, for the necessities of all the other planets, which are, if I may so say, of a purer mold, and their evaporations consequently more subtle. We are perhaps, among all the inhabitants of the worlds in our vortex, the only persons who required to have a more gross and thick air given us to breathe in. With what contempt would the inhabitants of the other planets consider us, if they knew this?"

"They would be out in their reasoning," says the Marchioness, "we are not to be despised for being enveloped with a thick air, since the sun himself is so surrounded. Pray tell me, is not this air produced by certain vapours, which you have formerly told me issued from the sun, and does it not serve to break the first force of his rays, which had else probably been to excess? I conceive that the sun may be veiled by Nature, to be more proportioned to our use."

"Well, madam," replied I, "this is some small introduction to a system which you have very happily started. We may add that these vapours produce a kind of rain, which, falling back upon the sun, may cool and refresh it, as we sometimes throw water into a forge when the fire is too fierce. There is not any thing but what we may imagine to assist Nature's address, but she has another kind of address very particular, which is to conceal herself from us, and we should not willingly be confident that we have found out her method of ac ing on her designs in it. In case of new discoveries, we should not be too importunate in our reasonings, tho' we are always fond enough to do it; and your true philosophers are like elephants, who, as they go, never put their second foot to the ground 'till their first be well fixed."

"The comparison seems the more rational to me," says she, "as the merit of those two species of animals, elephants and philosophers, does not at all consist in exterior attractions. I am willing to admit the judgment of both. Now teach me some of the latter discoveries, and I promise you not to make any rash systems."

"I will tell you, madam," replied I, "all the news I know from the firmament, and, I believe, the freshest advices you can have. I am sorry they are not as surprising and wonderful as some observations which I read the other day in an abridgment of the "Chinese Annals." Written in Latin. Those people see thousands of stars at a time fall from the sky into the sea, with a prodigious noise, or are dissolved, and melt into rains; and these are things which have been seen more than once in China. I met with this observation at two several times, pretty distant from each other, without reckoning a certain star which goes eastward, and bursts like a squib, always with a great noise. It is a great pity that these kinds of phenomena should be reserv'd for China only, and that our part of the globe should never have their share of these sights. It is not long since all our philosophers were of opinion that they might affirm on good grounds that the heavens and all the celestial bodies were incorruptible, and therefore incapable of change; and yet at the same time, there were some men in the other part of the earth who saw stars dissolve by thousands, which must produce a very different opinion."

"But," says the Marchioness, "did we ever hear it allowed that the Chinese were such great astronomers?"

"It is true, we did not," says I, "but the Chinese have an advantage from being divided from us by such a prodigious tract of earth, as the Greeks had over the Romans, by being so much prior in time: distances of every sort pretend a right of imposing on us. In reality, I think still more and more, that there is a certain genius which has never yet been out of the limits of Europe, or at least not much beyond them; perhaps he may not be permitted to spread over any great extent of the earth at once, and that some fatality prescribes him very narrow bounds. Let us indulge him whilst we have him; the best of it is, he is not link'd to the sciences and dry speculations, but launches out with as much success into subjects of pleasure, in which point I question whether any people equal us. These are such topicks, madam, as ought to give you entertainment, and compleat your whole system of philosophy.

ENGINEERING CONSTRUCTION AT THE INVENTIONS EXHIBITION.

ONE would almost think that engineering construction would alone afford a sufficient display to constitute an exhibition in itself. Indeed, although as a matter of fact, one small section of the building has been devoted to the hybrid Group III—engineering construction and architecture—the whole exhibition is, to a greater or less extent, stocked with products which would be equally in place were they included in the third group. The group comprises nearly 200 exhibits, some of which are large and highly instructive.

They are in the official catalogue prefaced by a concise review, bristling with facts and figures, of the work accomplished since the year 1862. Many of the features in this preface have historical significance. Thus, we are told that on May 2, 1862, two 21-feet steel rails were laid at the Chalk Farm Bridge on the London and North-Western Railway, for comparison with the ordinary rails, and were taken up in August, 1865; 9,550,000 engines, trucks, &c., weighing 95,500,000 tons had passed over them. They had outlasted sixteen faces of the iron rails, while only showing themselves a wear of about a quarter of an inch. Since that time the demand for steel rails has grown by leaps and bounds, and to-day they are turned out at the rate of 4,000,000 tons per annum.

Considerable interest surrounds the details afforded concerning the great European tunnels. The Mont Cenis tunnel, 7½ miles in length, traversing various strata of rock, many of which were of the hardest character, was commenced by hand labour in 1858. In the first five years the rate of progress by this means was 1·655 ft. per day at the Modane end. The introduction by M. Sommeiller of compressed air rock-drills driven by water power marked a great advance, and the rate of progress increased to 3·686 ft. in 1863, and further to 6·695 ft. per day in 1870, while at the Bardonnêche end the rates were 2·148 ft. by hand, 3·411 ft. by machine in 1862, and 7·989 ft. in 1870. The work was completed in 1871, having thus occupied fourteen years. The St. Gothard tunnel, 9¼ miles in length, commenced in September, 1872, was completed and opened for traffic Jan. 1, 1882, having occupied nine years and two months. The advanced heading was driven at the rate of 6·63 ft. per day at first, increased subsequently to 10·11 ft. per day by the adoption of the Ferroux drill. The headings, starting 9¼ miles apart, met with a deviation not exceeding four inches vertically and eight inches horizontally in less than seven and a-half years' work, the greater progress being due to the improved rock-drills, the use of dynamite, and compressed air locomotives. In the Arlberg tunnel, 6⅞ miles in length, which will form the connection

between the Swiss and Austrian railway systems, an advance of 10 ft. per day is made at one end by drills similar to those employed at the St. Gothard, at the other end 15½ ft. per day with Brandt's hydraulic borer.

In this country the Severn tunnel, 7,942 yards in length, of which 2¼ miles are under the estuary, 96 ft. deep in one part at high tide, is rapidly approaching completion. The large quantity of underground water met with caused unusual difficulties and some temporary stoppages. The Mersey tunnel, 3,820 yards in length, through red sandstone, of which 1,300 yards are under the river, is now completed. In the heading from the south side, a boring machine, invented by Col. Beamont and Capt. Fisher, has been employed. In this machine a bore-head 7 ft. in diameter, fitted with discs or cutters of chilled cast-iron, is rotated against the rock face by compressed air-engines. The cutters can be turned round as they wear, thus bringing a fresh edge to bear. The machine is advanced ⅜ in. each revolution, and has bored 15 ft. in twenty-four hours.

With reference to home railways, it is said that the number of passengers carried, on the part of the metropolitan line first opened amounted to 9,500,000 in 1863, during the past year it reached 114,500,000. The running of eighteen and nineteen trains per hour each way on the busiest parts of these railways over the numerous junctions and crossings, and that, too, with an almost complete immunity from accidents, is pointed to as showing the perfection to which railway working has now been brought.

The growth of street tramways, from their first introduction in their present form in 1867 to the present day, is briefly noticed, and considerable attention is bestowed upon those masterpieces of human ingenuity and skill—viz., bridges and viaducts, such as the International over the Niagara River, 3,651 ft. in length, with a swing portion of 364 ft., covering two spans of 160 ft., which can be opened or shut in one minute by steam-power. Then there is the Kentucky River Bridge, consisting of three spans of 375 ft., with a height of 275 ft. above low-water at the centre, which was built out from the two sides of the ravine simultaneously with no other staging than a temporary timber pier at the centre of each of the two land spans. The junctions of the different members at the centre were effected one at a time by slacking or keying up the lateral bracing, and taking advantage of the range of temperature (30° Fah.) between night and day. Among the other structures of this class referred to are the Brooklyn Bridge, the Douro Viaduct, the Kinsua Viaduct, the Tay Bridge, and the Forth Bridge.

Interesting details are furnished concerning harbours and the work involved in their construction, and a good word is said on behalf of electricity as a source of illumination for lighthouses.

The observations made upon the Suez Canal which was opened for traffic in November, 1869, are, at least for our younger readers, sufficiently fresh to deserve quoting. It is remarked that before the success of this great work was assured, numerous insuperable difficulties were anticipated by its opponents, but these have all been shown to be without foundation; thus it was stated by many persons that the evaporation from the surface of the Bitter Lakes, when water was admitted to them, would be so great that many years would be required to fill them, and that a strong current would always be maintained towards them, and that they would become completely choked up by a deposit of salt. But the entire space, containing 1,962,000,000 cubic yards, was filled from the canal between March 18 and October 24, 1869, and instead of a new deposit of salt taking place the old banks of salt were in six years dissolved away to the extent of 88,000,000 tons. Analyses of the water of the lakes showed that the saltness of the water increased rapidly at first as the banks were dissolved, but each year it has diminished, showing that a constant interchange of water between the lakes and the seas takes place. Observations show that the north and north-west winds prevailing from May to October raise the mean level of the sea at Port Said and lower it at Suez, producing in September a difference of level of one foot four inches, and causing a current from the Mediterranean to the Red Sea. In the winter the direction of the current is reversed by the prevailing southerly winds. The importance of this work to the commerce of the world is shown by the following table of the traffic through the canal:—

	Number of Ships.	Net Tonnage.	Receipts.
1870	486	436,609	£206,372
1877	1,663	2,355,447	1,310,973
1883	3,307	5,775,861	2,740,933

It is said, in connection with the construction of the metropolitan intercepting and outfall sewers, in all 82 miles in length, that these works involved the use of 318,000,000 bricks, 880,000 cubic yards of concrete, 3,500,000 yards of excavation, and the erection of pumping stations of 2,380 horse-power collectively, the total cost of the whole being £4,100,000.

With reference to the exhibits themselves, it is greatly to be regretted that they do not include models of at least a few of the magnificent monuments of human energy which have been reared within the past quarter of a century. Specimens, mechanical appliances, and a few models make up a collection which is far short of what in the year 1885 it ought to be.

The pet scheme of Sir E. Watkin, who is apparently ambitious to secure a position akin to that of M. de Lesseps, is exhibited in a prominent position by the Submarine Continental Railway Company. The proposed Channel Tunnel is illustrated by a series of models and maps. The first stand carries a model of the bed of the sea in the Straits of Dover, showing the course of the proposed submarine tunnel and the geological formation along its centre line. The second stand bears a model of the bed of the sea in the Straits of Dover, showing the submarine chalk formation at right angles to the centre line of tunnel; while the third has a model of a boring machine constructed by Messrs. Beaumont & Co. for the experimental works of the Submarine Continental Railway Company. There are three cartoons purporting to be:—(1) Map of the geological formation in the Straits of Dover, showing the course of the proposed submarine tunnel. (2) Longitudinal section of the proposed submarine tunnel, showing the bed of the sea and the geological formation along the centre line. (3) Cross sections of the geological formation taken at right angles to the centre line of tunnel.

Near the centre of the court is exhibited a few models of Roper's suggested appliances for blocking the proposed tunnel. One of these devices is to fill a portion of the tunnel with earth, stone, and rock by dropping the material from a reservoir above the tunnel. It could scarcely be urged, however, that such an obstacle could be very serious to men determined to get through.

An exhibit which is likely to attract some attention on the part of Londoners is that of Baines & Heath's water meters, which are claimed to be sufficiently accurate to measure to the dripping of a tap.

The very extensive and successful adoption of zinc for temporary buildings, &c., has recently borne fruit in the propagation of a number of plans for using the metal. The show made by Messrs. Braby & Co. is a good one, and is

not by any means confined to structural work. The details of properly apportioned houses are shown in many cases to be workable in zinc.

There is a very large display of artificial stone, marble, &c., but one of the hits of the exhibition is the show made by Messrs. Lindsay & Co. of fire-proof columns. The principle is a core of cast-steel, enveloped in a decent looking casing of concrete. This system has, we hear independently, already proved all that could be desired, and modifications are appliable to an almost endless variety of purposes. A model is shown of a bridge built and railed on this principle.

The proposed Manchester Ship Canal, and the periodically filthy state of the Thames envelop with unusual interest anything which promises to be of use in effectually controlling the flow of water, and the maintenance of the river-bed. Messrs. Wiswall & Collier exhibit a well-made model, on a scale of half-inch to the foot, of their Tilting Weir, as introduced for the improvement of the Mersey and Irwell navigation, and for the prevention of floods. A number of gates or panels are held in a tilted position in a way similar to what we should see were a number of boards rested against a table. Their line of suspension is below the centre of the gates, so that the upper portion is the heavier. The lower edge of each gate has attached to it a chain which, at its other extremity, is connected to a lever on the bank of the river. The bottom of the gates being toward the stream, the water collects until it tops the weir. Sir Frederick Bramwell, when before the Committee on the Manchester Ship Canal, said of the system that it appeared to him to be the very best system of opening weirs that he had seen. It had a great advantage in being readily worked by hand. In pointing out some of the merits possessed by the weir he said that the upper part of the panel being greater that the lower, when the water is only just topping the weir, the percentage of the extra pressure upon the bottom is obviously greater than the pressure upon the top but when the water rises the percentage of the pressure upon the bottom is diminished, and then the weir is capable of tilting. When there is no flood going on it is perfectly competent for the man in charge to open in succession one or two of these panels or gates, and allow the water to flow under rather than over, so that even in the absence of flood the current can be directed periodically across the whole width of the river, and along its bottom thereby keeping it clean. The river fitted with such a weir would be in as good condition as if there were no weir at all.

One of these weirs has been fitted at Throstlenest, and Mr. Hopkinson, Mayor of Manchester in 1882-3, said that it answered admirably under the test of two recent floods. The navigating depth of water had been improved, and the weir was now no obstruction in time of flood.

Close to this exhibit is a model of Mr. A. Dowson's system of open groynes for protecting foreshores. They consist of a framework of iron or other rods, and claim as their advantages their open construction, which, while arresting or trapping the shingle, allows the water to pass freely through the openings, and so preventing the backwash which generally renders solid groynes less efficient than could be desired. They are in use at Brighton, and at St. Anne's, near Blackpool.

A number of other models of a more or less interesting character are to be seen, including one of the Newhaven Harbour Breakwater, and another illustrating one pavilion of a projected military hospital for a hot climate, by Major-General Sir Andrew Clarke, R.E., and Mr. E. Ingress Bell.

Sailors and those who go down to the sea in ships will be pleased to see the advance that has been made in condensers for producing fresh-water. Specimens of condensers for different kinds of vessels, from a yacht upwards, are shown. The apparatus necessary for a yacht-launch or torpedo-boat will make fifty gallons of pure fresh water per day of twenty-four, on a low consumption of fuel. This quantity of water is sufficient to supply fifty men. The space occupied by the whole apparatus is small. The boiler is made of copper, with seven water-heating tubes in combustion chamber, and the whole can be taken to pieces for cleansing purposes by unskilled labour. The condenser can also be cleansed in place by simply blowing through with steam from boiler. The water is supplied to boiler by an "injector," or, that failing, the hand-pump can be applied. The condenser passes the fresh water into the receiving-tank without a pump, through a filter in the top of tank, and aërated ready for use. The total weight is approximately 300 lb.

There are several domestic appliances exhibited of greater or less utility, such as sash-fasteners, terra-cotta articles, wood-flooring, &c., one of the most striking being the exhibit of decorated enamelled iron. To some of these we may have occasion to refer later on.

In perusing the catalogue, however, one is apt to be startled by reading the following description of an exhibit: "Improved combined safeguard and rail-cleaner for tramways. The apparatus is applicable to engines and cars alike. The safeguard removes any person fallen on the ground without any injury, and prevents in all cases neither the person nor any part of the body, as legs, or arms, or hands, to come into contact with the wheel and being crushed or otherwise injured, even in cases of children of any age. The apparatus is lowered and lifted either directly or automatically. The rail-cleaner fixed to engine or car keeps the groove clean, can be set to work or be lifted out of the groove according to the requirements of the service, and thus reduces the tractive power required of horses to one-sixth of its normal conditions."

The number of visitors to the Exhibition last week was 87,460, making, during the first three weeks it was open, 280,009. On Monday there were 73,634—a greater number than was recorded on any one day during the time the Fisheries and Health Exhibitions were open.

TRICYCLES IN 1885.

By JOHN BROWNING.

(*Chairman of the London Tricycle Club.*)

MAPS FOR TRICYCLISTS.

NEARLY all travellers delight in maps, and even pass hours pleasantly in poring over them. To tricyclists maps are indispensable. Route-cards are no doubt valuable, but, should circumstances render some departure from the intended route necessary, a map must be resorted to.

The best maps published in England are those of the Ordnance Survey. These are from data taken by the Royal Engineers, and they are sold at the offices of the Ordnance Survey in St. Martin's-lane, W.C. Those drawn to a scale of one inch to a mile are the only kind adapted to the use of tricyclists. They are issued in sheets 18 in. long by 12 in. high, including country eighteen miles by twelve, and are published at one shilling each sheet. As elevations are very fully and accurately shown on them, the relative advantages and disadvantages of different routes can readily be determined; they are therefore admirably adapted for consultation when planning a journey. But being printed

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on stout drawing-paper, and requiring many sheets to include the country that can be covered in a day's ride, they are too bulky to carry about with you when riding. All other maps published are based on those of the Ordnance Survey, and are generally only reductions in scale from them, whoever may be the publisher.

Messrs. W. H. Smith & Sons publish a set of reduced Ordnance maps, on the scale of four miles to the inch. These are well engraved, and as they are published in sheets, containing a district of about seventy miles by fifty, mounted on cloth in covers, at 1s. each sheet, they are exceedingly cheap; but they have the great fault that the roads are not at all clearly shown, and elevations are not given.

Messrs. Letts & Son publish a map specially for cyclists, on the scale of four miles to one inch. This map embraces an extent of country 96 miles by 85, and therefore contains nearly 7,700 square miles. An idea of its extent may be formed from the fact that it includes Buckingham, Harwich, Portsmouth, Eastbourne, and Ramsgate. The principal elevations are given, and the best roads are indicated by being printed in colours, and dangerous hills are marked. It is bound in cloth, and folded so small that it will go easily into the pocket. The price is 2s. 6d., or mounted on linen 5s. Every tricyclist should have this map.

Messrs. George Phillips & Son have published a set of county maps specially for cyclists. They show the main roads in colour, dangerous hills in three different degrees, and the direction of the danger; places where there are hotels which cater specially for cyclists, in connection with the Cyclists' Touring Club; also where there are repairers of machines who can be recommended in case of accidents. In some of the counties—for example, Sussex—the scale is too small to enable the roads to be followed easily. These maps are folded in cloth cases, and published at 1s. each county, or mounted in cloth 2s.

The same firm has published a map extending from St. Albans on the north to Reigate on the south, and from Chatham on the east to Windsor on the west. This is on the most convenient scale of all, half an inch to the mile, as it gives space for considerable detail and is yet portable enough to go into the small valise carried on the tricycle by every rider. This map is printed in colours, and the main roads are shown by being coloured brown. It is published folded in a cloth cover for 1s., and mounted on linen the price is 2s. 6d.

Another map on the same scale would embrace all the country between Reigate and Brighton. This would be a great boon to cyclists, and, as it is well known that the happy hunting-ground of the numerous London riders lies in this direction, I feel tolerably sure the publishers would find the issue of such a map remunerative; and, if so, they might be tempted to issue another of the country north of London, in which case, as far as maps for cyclists are concerned, there would be little or nothing more to be desired.

Ancient Greek Colours.—The acquaintance of the ancient Greeks and Egyptians with the properties and applications of colours is proved by the traces of decoration found on ancient monuments, both architectural and sepulchral. Information derived from other antiquarian sources has enabled Dr. Landerer, of Athens, to contribute an interesting article to the *Wochenschrift für Spinnerei und Weberei*, according to which black, grey, and brown colours were known in ancient times, as also purple dyes of vegetable and animal origin. Wool was dyed with purple twice, and the necessary brilliancy of tone was imparted to it by a special process. Some ancient veils discovered in a tomb were found on careful investigation to bear traces of the application of metallic colours.—*The Dyer.*

FIRST STAR LESSONS.

By Richard A. Proctor.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct) :—

1. *Ursa Minor*, the *Little Bear* (*a*, the *Pole Star*).
2. *Draco*, the *Dragon* (*a*, *Thuban*)
3. *Cepheus*, *King Cepheus.*
4. *Cassiopeia*, the *Lady in the Chair.*
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*a*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*a*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*a*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair.*
10. *Boötes*, the *Herdsman* (*a*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown.*
12. *Serpens*, the *Serpent.*
13. *Hercules*, the *Kneeler.*
14. *Lyra*, the *Lyre* (*a*, *Vega*).
15. *Cygnus*, the *Swan* (*a*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse.*
17. *Andromeda*, the *Chained Lady.*
18. *Triangula*, the *Triangles.*
19. *Aries*, the *Ram.*
20. *Taurus*, the *Bull* (*a*, *Aldeburan*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*a*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*a*, *Regulus*).
24. *Virgo*, the *Virgin* (*a*, *Spica*)
25. *Libra*, the *Scales.*
26. *Ophiuchus*, the *Serpent Holder.*
27. *Aquila*, the *Eagle* (*a*, *Altair*).
28. *Delphinus*, the *Dolphin.*
29. *Aquarius*, the *Water Carrier.*
30. *Pisces*, the *Fishes.*
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River.*
33. *Orion*, the *Giant Hunter* (*a*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*a*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*a*, *Alphard*).
36. *Crater*, the *Cup* (*a*, *Alkes*).
37. *Corvus*, the *Crow.*
38. *Scorpio*, the *Scorpion* (*a*, *Antares*).
39. *Sagittarius*, the *Archer.*
40. *Capricornus*, the *Sea Goat.*
41. *Piscis Australis*, the *Southern Fish* (*a*, *Fomalhaut*).
42. *Lepus*, the *Hare.*
43. *Columba*, the *Dove.*
44. *Canis Major*, the *Greater Dog* (*a*, *Sirius*).
45. *Argo*, the *Ship.*

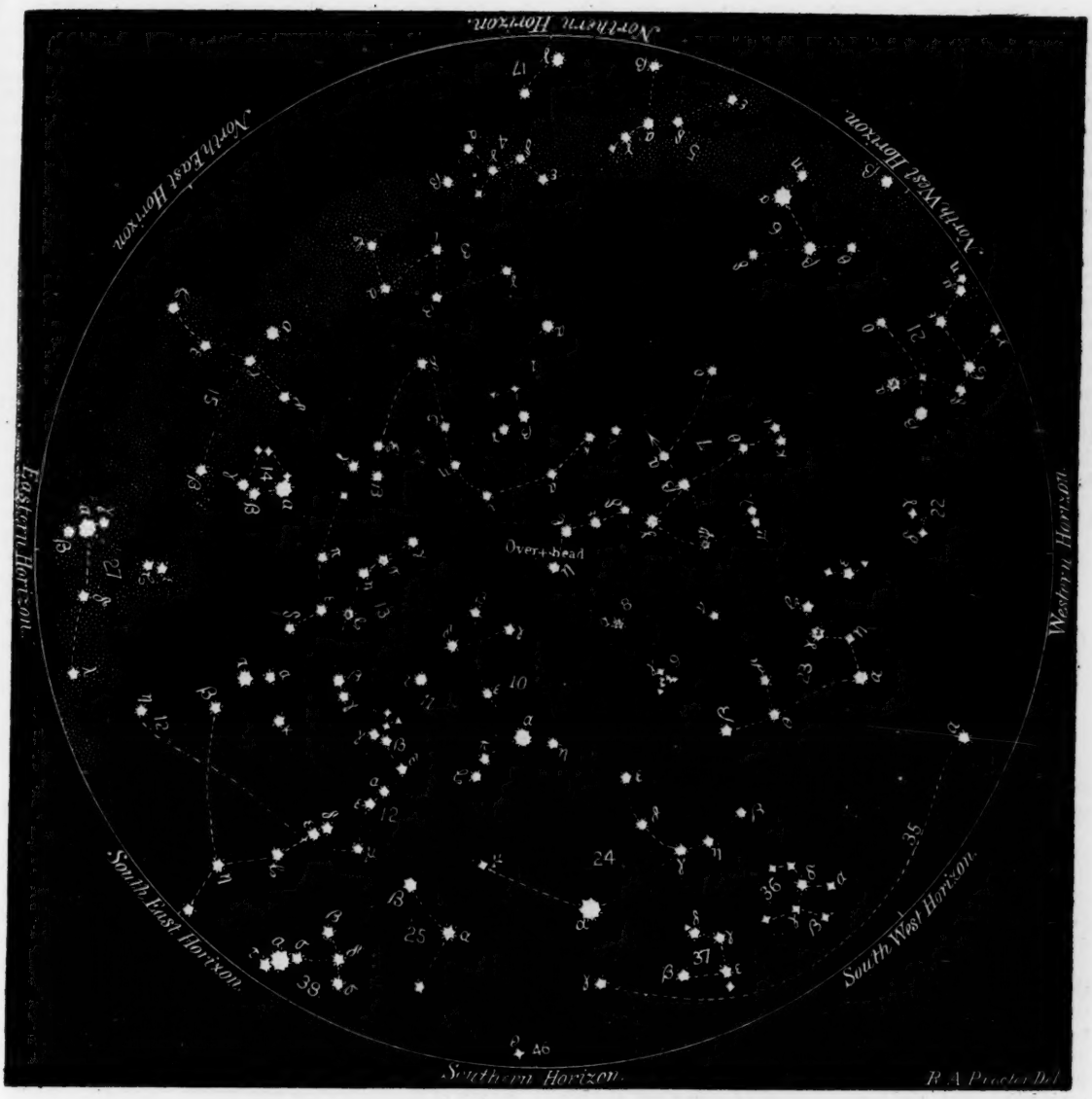
CHAPTERS ON MODERN DOMESTIC ECONOMY.

XXIX.—THE FRAMEWORK OF THE DWELLING-HOUSE.

STRUCTURAL EXAMPLES (*continued*).

THE DISPOSAL OF HOUSEHOLD REFUSE.

ANOTHER distinct type of appliance, and one which we have not hitherto alluded to, is the form known as the "Solid Plug" Closet, of which there are very many kinds in the market. The distinctive peculiarity of these closets is that the mechanism employed to seal a sufficient quantity of water in the basin, consists of a solid plug which is lifted by the handle perpendicularly up and down, and it obviously follows that in all these cases the outlet must of necessity occupy a lateral position, as in the variety of wash-out basins noticed in our last. The action of the common form now in use is somewhat as follows :—When the pull-up handle is raised, the bulk of water with its contained refuse flows out through the outlet; but upon forcing the handle back, the plug, in descending, is apt to wedge in a small quantity of foul matter, and unwholesome gases are thus generated, to escape directly above through the aperture provided for the passage of the handle rod. This is more particularly noticeable when there is a trapped overflow connected with the inferior trap, or the soil-pipe, below the region of the plug.



NIGHT SKY FOR MAY (SECOND MAP OF PAIR),

Showing the heavens as they appear at the following hours:—

May 21 at 10 o'clock.	May 29 at 9¼ o'clock.	June 5 at 9 o'clock.
May 25 at 9¾ o'clock.	June 2 at 9¼ o'clock.	June 9 at 8¾ o'clock.

More often than otherwise, the solid plug apparatus is looked upon as complete in itself, and is fixed to the soil-pipe without any intermediary trap. The plumber labours under the delusion that the water-seal within the basin is amply protective against the rise of sewer-gases into the house through the closet; and so it would be if it were possible to establish a full and perpetual downflow when the handle is raised; but, as a matter of fact, an up-draught almost always enters on account of defective ventilation of the drains; and then, too, the handle is liable to get out of order, and remain fastened up, in which case a continuous inflow of foul gases must inevitably follow.

About the best form of plug closets hitherto introduced is that known as "Pearson's Patent Twin-Basin." It is made in a single piece of white earthenware of the best manufacture. It consists of a double basin, the larger of which is situated in front of, and divided by a partition which dips into the water seal, from the smaller. The refuse from the former is effectually flushed outwards and downwards through the outlet which is placed at the bottom of the latter, and in which a carefully-constructed solid plunger is made to lift up and down by means of a vertically-disposed pull-up handle. The overflow, should there be any, is controlled by a ball-valve arrangement within the smaller back chamber, and should preferably be

carried away from the special outlet at the side of the basin, through the wall, into the open air as a warning-pipe.

One very excellent provision which is furnished with Pearson's Twin-Basin is the "Brian Jones's Joint," for hermetically connecting the closet with the soil-pipe. It is essentially a "tongue and groove" joint, and there can be no doubt that, when properly fixed, it effectually prevents the escape of sewer gases at a point where so very many otherwise perfect appliances are defective.

The last form of apparatus which we shall have occasion to mention is that known under the name of the "Hopper Closet." When we were dealing with the general principles of construction, we alluded to the prevalent and very inefficient elongated conical basin, popularly termed a "Long-Hopper;" here there are many serious defects to be got rid of, over and above the obvious one that the basin does not afford a hold for a small quantity of water at all times. The water-supply is generally placed so close over the seat, and the supply-pipe is of so small a bore (often less than 1 in. in diameter) that sufficient flushing power is impossible. The basin itself is almost a true vertical, elongated cone, and is provided at the top with an inlet-arm for the water, which, even provided that it is delivered in a large quantity, and with a powerful motion, only whirls round and round the basin, which it does not even cleanse, and which is insufficient to sweep out the trap beneath it. The traps usually furnished for hopper-closets, which are to be recommended, in their modified forms, principally for basements and out-houses, are generally made of earthenware and of the syphon or P and S type, as shown in Fig. 31.

Fig. 31.

In the improved variety of hopper-closet there ought to be a basin, in which the back is made more vertical than the front, and in which the water is admitted all round the basin through a flushing rim, in such a manner as to thoroughly wash down its sides, and as the same time flush the stoneware trap clear of all obstructions.

The closets in a house are by no means the only channels through which foul air from the house-drain or badly-connected sewer can enter the building; they are, indeed, the most apparent of all such sources, and in a general inspection are not likely to be overlooked by the would-be tenant of a healthy abode, especially where such an one is conversant with the various types of apparatus, the pan, the valve, the solid plug, the flush-out, and the hopper, and with the defective as well as the perfect forms which it has been our endeavour to explain in these pages. There are many other ways in which sewer-gases find access into the chambers of the dwelling, both direct and indirect, the chief of which are very prone to be overlooked, since their presence is often taken to be a safeguard rather than the reverse. We were reminded of this only a few days ago whilst overlooking some really good dwelling-huoses in the vicinity of Lambeth.

In one particularly desirable "Grove," where the external appearance of the houses, their nicely laid out plots of ground in front and behind, modern artistic paper-hangings, excellent bath-room, &c., warranted a healthy state of affairs, we were astonished to find all the drains out of order. The pan-closets with their D-traps, were in good working order, and could have been forgiven by the side of the numerous abominable outlets for sewer-gases into that most important department, the kitchen. If there is one place more than another where poisonous gases are able to exert their baneful influences in a most decided way, it is in the kitchen and the larder. Fresh uncooked meats of all kinds are peculiarly sensitive thus to become tainted, and spread disease surely and rapidly; and yet it is within the kitchen and scullery or their precincts that untrapped or badly-trapped vents, open to poison the food and air alike; so that, in continuation of the subject of efficient drainage, and the disposal of household refuse, we shall draw special attention to the existing forms of apparatus used in yard and sink drainage, with comments upon their respective values as adjuncts to a healthy home.

Editorial Gossip.

I referred on p. 396 to a report that experiments were in progress at Valencia on inoculation for cholera. Since then, more definite information has reached this country in the shape of a telegram from Dr. Ferran to Dr. Cameron, M.P. for Glasgow. According to this, an epidemic of cholera is raging at Alcira, a town near Valencia, containing 16,000 inhabitants, of whom up to the first of this month 5,432 had been inoculated with the protective choleraic virus. Hence some 10,500 persons have not been inoculated, and of these 64 have been stricken with cholera, and 30 have died. Of the 5,432 inoculated, 7 only have been attacked, and all have recovered. If we may regard these statistics as trustworthy—and there is apparently no reason to doubt them—it would seem that this Spanish physician has conferred a benefit on mankind akin to the inestimable one of vaccination by Jenner.

And, apropos of vaccination, the attempt of Mr. Hopwood to make capital out of an outbreak of small-pox at West Ham has proved an ignominious failure. It would appear that 98·7 per cent. of the population there is vaccinated, leaving, of course, 1·3 per cent. unvaccinated. Now in the Guardians' Small-pox Hospital at Plaistow the 98·7 per cent. of the population has contributed twenty-nine deaths, while the (unvaccinated) 1·3 per cent. has contributed no less than seventy-six deaths, thus showing that the mortality among the unvaccinated classes was, in proportion to their number, 200 *times that of the mortality among those vaccinated.* Surely so patent a fact as this might well arrest the attention of Mr. White, or even of the honourable member for Stockport himself.

From a private letter which I have been permitted to read I learn that that excellent astronomer and single-hearted man of science, Mr. E. Neison (the author of our classical English work on "The Moon") is sustaining his reputation as head of the Natal Observatory. At present he is engaged in the reduction of all tidal observations on Darwin's System, and for this purpose has had to educate every computer, step by step, himself. He has recently built a wing to the observatory at his own sole cost and charge; in fact, the recipient of the letter from which these details are derived says:—"N. spends at least £300 a year out of his own private purse to keep the observatory up." Surely at a time when the public pocket is picked for such shams as Committees on Solar Physics and the like, such noble disinterestedness in the cause of science such as this deserves all the publicity that can be given to it.

CAN any of our ornithological readers say what has become of the cuckoo this year? I will not say that I have not heard him, but his appearance, or more strictly speaking his song, has been rarer than ever I remember it. The old rhyme goes:—

In April come he will,
In May he sings all day.

But assuredly during the present month he has not only not sung all day, but many consecutive days have elapsed without a sound of his voice. Reading that "Between 45° 55′ W longitude and 41° 44′ N latitude (whatever that may mean) unusual and dangerous quantities of ice are floating just now," it occurs to me that possibly the bird (whose Scottish name is synonymous with that of a fool) may be labouring under the illusion that it is the beginning of February instead of the latter end of May.

WELL within the memory of many who will read these lines, to-day was set apart as one of thanksgiving by the Church of England for the "restoration" of that most contemptible creature Charles II. Any one who will remember how that monarch sold this country to France; how he brought England to such a condition that (as so vividly told by Pepys) the Dutch during his reign forced their way up to Chatham, and, as says the immortal diarist, "broke the chaine and burned our ships, and particularly 'The Royal Charles;'" and who has learned from Evelyn how he spent his last most shameful Sunday upon earth, can scarcely fail to be lost in amazement at the combined sycophancy and superstition which can alone have prompted the institution of such an awful mockery of "thanksgiving!" Luckily, reverence and common-sense alike expunged the service from the Prayer-Book in 1859.

Reviews.

THE REVISED VERSION OF THE BIBLE.*

SCANTY though the library may be of any man of the English-spoken races, it is but rarely indeed that it does not include the Bible. For, surely, no single work has ever exercised the influence upon our national life, or so interpenetrated it in its social, domestic, and political (to say nothing of its religious) relations, as the Bible has done. And although the old theory of its inspiration has, perforce, been abandoned by earnest and serious thinkers, its influence upon the more highly civilised portion of the human race has in no perceptible degree diminished; nay, it would rather seem that at no period was popular opinion more prone to insist on public recognition of much in it, which, by many in private, is doubted or denied. Whether, though we view it as the store-house of some of the most ancient history that has descended to us, as a repertory at once of sublime poetry, and of the wisdom and philosophy of a most remarkable people, or as an ethical code whose increasing purity may be traced through each succeding one of the heterogeneous mass of books of which it is composed, the grave importance of possessing the most accurate and literal possible rendering of its contents must be equally apparent. Now, the Revisers have really made so comparatively few alterations, that they have almost to be purposely sought for to be recognised. Some of them are manifest improvements. To go no further than Genesis i, 5, "And there was evening and there was morning, one day," gives the sense of the original much better than the rendering in the Authorised version. We shall be curious to see how the geological "reconcilers" twist this into a "period." Elsewhere they have been less happy, as in their rendering of Job xix. 25, 26 and 27, in which Job's mere expression of opinion that he will yet be freed from his loathsome skin disease, and be shown to be innocent, is given in a form which is nearly as susceptible of being twisted into a pseudo-prophecy as that to which we are so well accustomed. We are bound in candour to add that in some of their renderings in this very book they have introduced the most undoubted improvements, and exhibited the sense of the original for the first time. The Revisers of the Old Testament have certainly performed their allotted task in a more impartial and (we use the word in no offensive sense) honest manner than those of the New, whose retention of such undeniably spurious passages as that in 1st John 5, and interpolation of the word *one* after "evil" in Matthew vi. 13 for purely doctrinal purposes, so seriously impairs the critical value of their performance. Taken as a whole, this revised version of the Scriptures may be looked upon as the outcome of the ripest scholarship of the age, and as such should, of course, be procured and studied diligently by all to whom the Bible is anything more than a mere word. It is not unworthy of mention that the very earliest MS. of the Old Testament of which the age is definitely known bears the date of A.D. 916, or 150 years before the advent of William the Conqueror and the Battle of Hastings!

* The Holy Bible . . . . being the version set forth A.D. 1611 compared with the most ancient authorities and revised. (London: Henry Frowde and C. J. Clay & Son.)

EUROPE.*

BY EDWARD CLODD.

THIS useful volume, independent in itself, is one of the series of the "Compendium of Geography and Travel," based on Von Hellwald's "Die Erde und ihre Völker" ("The Earth and her Peoples"). The original translation, made by the competent pen of Professor Keane, had to be recast to adapt the work to the other members of the series, and, more especially, to secure for it that completeness in the physical section which Sir Andrew Ramsay's supervision insures.

The book has gained throughout from this revision. It is divided into two parts, the first of which is occupied with a description of the physical features of the European Continent, and the second with its political states and peoples.

The interest and value of the work are sustained from cover to cover, and one notably praiseworthy element is the accurate and lucid survey which is given of the changes resulting in the present distribution of land and water, and which are still operating on the configuration of these in more or less perceptible degree. Of the numerous maps elucidating the text, and which are up to the usual high level of Mr. Stanford's publications, the first illustrates the physical history of the Mediterranean basin, and the oscillations to which that part of Europe has been subject. Geological action has broken the connections between Europe and Africa which formerly separated that deep sea into three large land-locked basins, the positions of which are ascertained by Admiral Spratt's soundings. And in explaining these, the writers are careful to point out the beneficial results to man of the extended coast-line in ensuring the development of centres of civilisation,

* "Europe." By F. W. Rudler and Geo. G. Chisholm; edited by Sir Andrew C. Ramsay; With Ethnological Appendix by Professor A. H. Keane. (London: Edward Stanford, 1885.)

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and in facilitating intercourse between East and West. Whilst the sea has thus burst its barriers in that direction, there have been local recessions before the sediment which has been brought down by fluvial action, and this operation is admirably explained in the chapter treating of the hydrography of the Po, which, the authors remark, "in its behaviour may be looked upon as a typical river." If the account lacks the eloquence with which Mr. Ruskin describes the movement of that river in his story of the deposition of the sands on which Venice stands,* it falls no whit behind in clearness and instructiveness. The map of the Po basin in the Glacial epoch which is given shows the extension of the sea at that period over the plains of Lombardy and Piedmont as far inland as Turin, the proof of this being in the marine shells of extant species found at no great depth beneath the alluvial sediment deposited by the Po. During that epoch the river, born amongst the "aged snows," was fed from the ice-caverns of the huge glaciers which then filled the Alpine valleys, and of which the glaciers of to-day are the shrunken and slowly-diminishing successors. These monster ice-ploughs furrowed the valleys deeper, and ground the rocks that clasped them into powder, which was borne in solution by the river and spread out as fruitful soil, from which was to spring the corn, the olive, and the vine. The same resistless agency—water, solid or liquid—is busy to-day, riving asunder the porous and saturated rocks till the big fragments slide down their sides in avalanches, or, in the more noiseless process of denudation, washing these rocks away particle by particle, till the highest crests of Matterhorns and less isolated peaks shall be levelled, and even the lovely lakes of Switzerland and Northern Italy be choked with the boulders and filled with the alluvium of the so-called "everlasting hills."

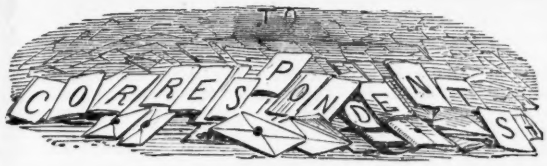
Throughout the physical section the authors have wisely based their exposition on the general principles set forth in Professor Geikie's masterly paper on "Geographical Evolution," and to the same authority are probably due the suggestive observations on the numberless changes which have left so little of the material of the original Europe. But the temptation to dwell on that interesting story must be resisted, and it will here suffice to repeat commendation of the earlier part of the work as affording an excellent conspectus of the general causes determining the present aspects of the European continent.

The heterogeneous ethnical elements in the peoples of Europe are treated of separately in the several political groups, but upon the general subject of the ethnology and philology of the European races the appendix furnished by Professor Keane, which is the distinctively valuable feature of this, as of the preceding volumes, should be carefully studied. It begins with a survey of the earliest inhabitants of Europe—the men of the Stone Ages, whose relation to any existing stocks is unestablished. Of the most ancient race, the savages of the Drift (whether pre-Glacial or inter-Glacial, is unsettled), nothing whatever is known, save that they then appear to have been widely spread over both hemispheres; nor, in view of the enormous duration of the Ancient Stone Age, and of the bridgeless interval between it and the Newer Stone Age which is continuous to this day, can possible links between successive races be recovered. Professor Keane hardly lays stress enough on the different geological conditions of these Ages, or on the remoteness of the one in contrast to the historic nearness of the other. But, despite these differences, there are no sufficient grounds for the common assumption that the latest men of the Old Stone Age and the earliest men of the Newer Stone Age were racially distinct, or that a vast untenanted interval separates the latest epoch of the Old Stone Age from the earliest epoch of the Newer. It is true that in the former, Britain was still united to the mainland, and that in the latter it was separated; but, impassable to savage races as the sea between us and the continent may now be, the channel which divides England from France may then have been a fordable river, across which races in slowly advancing civilisation passed and intermixed. Be this as it may, "the problem of the true relation of prehistoric man to the present inhabitants of Europe remains an unsolved riddle."

The composite character of these last is next explained; the assumption of an Aryan stock pure and unaffected by non-Aryan stocks, is dismissed; but Professor Keane, while admitting that the great linguistic families of Europe —the Aryan and the Finno-Tatar—correspond, on the whole, with the racial affinities of the peoples comprised within them, is careful to insist on what philologists have too often ignored, that "speech and race are not convertible terms." As illustrating this, he remarks that "within two generations the victorious Northmen of the Seine valley completely forgot their Norse tongue and adopted the Romance of their Gallic subjects. These Gauls themselves had, on the other hand, previously changed their old Keltic speech for the Latin of their Roman masters. In this region of northern France, there have thus arisen racial complexities of all sorts, but never any permanent linguistic confusion, one language simply displacing another without producing any mixed forms of speech, which, if they exist at all, are certainly the rarest of philological phenomena." In treating of the subdivision of the great European families, the interesting question of the Asiatic or European origin of the Aryans, which has come more to the front lately, is discussed, the opinion of Professor Keane inclining in favour of Asia. But any survey of the arguments *pro* and *con* would fill too much space; and, moreover, the subject has a quite subordinate value to the larger one respecting the races in whom perchance both Aryan and non-Aryan may find a common ancestry, belying the Professor's definition of the fair Caucasian and yellow Mongolian as "two everlasting primeval elements." Enough has been said to indicate that the Appendix is of singular value throughout, and its learned author, in the absence of any authoritative manual on the subject, would render a service to ethnology by collecting the several appendices, with necessary additions of races not comprised in the series, and issuing them in a separate volume.

* *Vide* "Stones of Venice" (both large and small editions); chapter "The Throne."

Royal Victoria Hall, Waterloo-bridge Road.—On the 19th inst., the last of the season's series of penny lectures was given by Professor Perry on "Spinning Tops." The lecturer described the curious rigidity produced by rapid motion, showing in illustration, smoke-rings. Spinning-tops do not fall down; when thrown about their axes maintain their original directions, as the axis of the earth does, the earth being, in fact, a gigantic spinning-top. A top in motion does not fall down, but rises up gradually to its highest position. When struck, it does not move in the direction which might be expected; a blow towards the north, for instance, makes it move towards the west. Various peculiarities in the motions of tops were shown in illustration of similar motions in the axis of the earth. The motion known as precession, for instance (which causes the axis of the earth slowly to alter its direction, so that 13,000 years hence our seasons will be reversed), was shown to be analogous to the circles described by a spinning-top. It was also explained that the paths of rifle bullets depended on the same laws which govern spinning-tops. A very attractive variety entertainment has been provided for the Whitsuntide holidays. The annual Flower Festival for children will be held to-morrow afternoon (May 30), from 2 to 4 o'clock.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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THE RUDDY ECLIPSED MOON.

[1722]—I have referred to the communication of "Senex," in vol. 6, page 324, and find that it confirms the observations I described of the great variability of the kind and degree of illumination of the eclipsed moon, and it goes further by showing that there is not only a great difference between two eclipses, but also between the appearances presented by the same eclipse when viewed from different places. We all agree in ascribing these differences to variations in the condition of our atmosphere. Those who attribute all the light on the eclipsed moon to refracted sunlight describe the presence or absence of clouds on the terrestrial horizon as the sole cause of the difference. According to my view of the cause of the ruddy element of the illumination, its variations depend upon the varying transparency of our atmosphere to the obscure heat rays. W. MATTIEU WILLIAMS.

ULTRA-GAS.

[1723]—I find that your reply (in the number for April 17) does not completely clear up my difficulties. "I see nothing more in the theory of ultra-gas inconsistent with the Newtonian theory than I do in that of ordinary gas, in which the repulsion of the molecules by heat overcomes their gravitating tendency; or in the fact that my holding a ball in my hand prevents it from reaching the surface of the earth."

But these two cases seem to me to show that the law ("gravity varies inversely," &c.) is obviously open to exceptions, such as, "unless some greater influence be opposed." Material obstacles, magnetism and heat, are influences to the point. Why not distance also? Have we any data for the behaviour of bodies reciprocally at great distances from each other? You continue (as would any one) "that attraction, infinitesimal as it is [that of the sun and Arcturus] still exists."

Suppose a body at the distance of Arcturus at rest, and all other bodies destroyed except the sun; would it move towards him? I think it is universally held that it would. I would ask on what grounds this belief rests. Magnetism is a phenomenon analogous to gravitation (only much stronger?), yet the strongest magnet will not attract the smallest particle of iron *beyond a certain distance*. The Conductor of KNOWLEDGE has remarked somewhere that it is rash to suppose all bodies to be moving in curves; that probably many stars move in straight lines. I do not see how this can be if there is even the very least pull on one of them from the nearest larger body. If gravitation be indeed true for all distances, then I do not see how any body can avoid an orbit. It will be replied, that their rate of translation will overcome the pull of the nearest body; but there, again, seems another exception to the universality—or, at least, the autocracy—of gravitation.

"Do you think I shall get anything out of that cove?" asks one impostor of another. "*Yes;* he will give you in inverse proportion to his penetration," is the reply, apparently affirmative, but really negative.

In certain cases there is no attraction, nor *repulsion*. Why should not this be the case with all matter in some degree?—the repulsion existing only at distances beyond our use.

I once asked Sir G. Airy what reason there is for concluding that the velocity of light is everywhere uniform? He replied that analogy leads us to believe that the ether is uniformly dense. I do not see this at all. Why may not the neighbourhood of a highly-irritating body, like a star, change materially the undulations? I proposed that it should be decided by the eclipses of Saturn's satellites; but I do not suppose this has been done.

Up to 1877, "all metals after fusion congeal again." Analogy would *insist* on this as a *universal* law. But then gallium was discovered, which is solid up to 80° F, then melts, but *never* becomes solid again. Analogy would lead us to proclaim that all the satellites are direct; those of Uranus are found to be retrograde.

Gravitation, beyond certain distances, seems to me to be like minus quantities, or the *n*th power—convenient and necessary terms, but not real anywhere out of Wonderland or "Flatland," where they have but two dimensions.

As regards infinite greatness, I think the Conductor of KNOWLEDGE has remarked somewhere, that space *cannot* be infinite; but I forget the reason given. And, as to infinite smallness, I think we may conceive of a mathematical point (otherwise how demonstrate anything?), but *not* of anything less. HALLYARDS.

[Is "Hallyards" quite sure that it was not a correspondent of this journal, and not in the very least its Conductor, who categorically denied the infinity of space? Furthermore, seeing that a mathematical point only defines position, and has no dimensions whatever, it would be rather hard to conceive of anything less!—ED.]

SUNDIALS FOR MEANTIME.

[1724]—"D. X. L." can plot the profile of each gnomon thus:—

Slender gnomon used from Christmas till June 15. Let n be difference of time between apparent moon and 12h. 5m. 18s. More bulging gnomon from June 21 till December 20. Let N be difference between apparent noon and 11h. 54m. 58s. In both cases, s = the time in column-headed "*Sidereal*," &c., of p. 1 of each month in "Nautical Almanac," and D = Declination (same line of same page). $N+s$, or $n+s$ must be put into degrees and minutes, *i.e.*, quartered. For an abscissa of either profile, measured from its mid-length, take

$$\text{Tan D } (1-\sin^2 \overline{N+s}),$$

$$\text{or Tan D } (1-\sin^2 \overline{n+s});$$

and for the corresponding ordinate take

$$\text{Sin } (N+s), \text{ or sin } (n+s).$$

Any year's Almanac will do. E. L. G.

AN "EYE-OPENER."

[1725]—To such of your readers as may be desirous of ascertaining, by practical trial, how wide their eyes can be made to open under proper stimulation, I beg permission to indicate through these columns, as a subject for their attention which will have that effect in (I think) an agreeable and progressive manner, the article in an illustrated monthly scientific journal of comparatively recent origin, entitled "The Basis of Perspective." I will not spoil the experiment by any indications as to the nature of the surprise which awaits them.

I regret to say that bitter experience prevents my attaching my name to this suggestion. I therefore subscribe myself ALIAS.

ON TERMITES.

[1726]—With reference to the remarks of "George Hann," No. 1628 of KNOWLEDGE, March 6, 1885, and "Commentator," No. 1638, of March 13, I beg to state that I am in no way a believer in the doctrines of natural selection or evolution.

I lately propounded a difficulty to the Editor of KNOWLEDGE, but he didn't publish it. It was this:—By what process of evolution or natural selection is the dūmba (two-tailed) sheep of Afghanistan matured which cannot reproduce its kind without the assistance of man?

But, abandoning "nos moutons," "revenons a nos termites;" my paper was by no means exhaustive; for instance, I was silent on the fact that the flight is the perfection of the insect; contact with atmospheric air, and especially absorption of oxygen and perhaps moisture complete the development of the termite and prepare the survivors for the process of reproduction.

Recollect that in the flight there has been no feeding or alighting, the male, after impregnation of a female, returns underground to die; and the fertilised female has no one to feed her, and no means, apparent to us, of procuring food, and she must wait until the developed workers from the eggs she is still to lay can undertake

the duty. The natives say that termites habitually eat earth; the isolated females may do so while awaiting development of their progeny.

In the case of termites on the wing, it is not the fittest but the luckiest who survives. The first perfect insect which emerges may at once be sprung upon by a sparrow, lizard, or fowl; if it succeeds in soaring, it has to run the gauntlet of the whole feathered race on the wing; and again when it alights, foes of all kinds are to be encountered. It is curious to watch the vagaries of an amorous male termite when his lady-love has been snapped up off the ground. He hunts hither and thither, as if by scent, until bumping up against another pursued female, he joins pursuit as second admirer, perhaps to find himself, in the end, in the maw of the same sparrow or fowl which devoured his first-born.

R. F. Hutchinson, M.D.

Please add an additional correction to my paper on p. 143, line 13 from top, for "anxious" read "amorous."

[Will Dr. Hutchinson kindly refer to column one of p. 39 of the current volume of Knowledge?—Ed.]

DUALITY OF BRAIN.

[1727]—Kindly allow me to describe my own experience. I am a telegraphist, employed by a railway company, my duty being to signal (telegraph) trains passing the station, and to receive trains from other stations. There are seven instruments, and a fair amount of work. Now, I can hear the train reporter call out to me a train whilst booking another and be taking from another station a train, all three things being done at the same time. Again, I can call two separate stations with distinct calls, one left and one right hand, notice what is being said on other circuits, and make remarks to those with me on what is being said (though the latter is rather irksome).

Often have I caught myself in a partly unconscious state to surroundings. When I have a train to send, have called station and sent it, booked it, and have not been aware of it. Sometimes I have taken several trains, booked them, and a moment or so after have been surprised to find them received, and by no means can I recollect having taken them. (At these times I have been thinking on subjects removed from "railway work.") It has taken some little practice to enable me to call two stations at the same time as reading other stations working.

I shall be glad if anyone can say if practising doing several things at one and the same time in injurious or beneficial to the brain, seeing that you can only recollect one of the things in some cases, and in others neither, yet be aware you were doing something, yet, the spell having broken, cannot recollect.

Onward.

[In observing the transit of a star over the wires of a transit instrument the observer has to count the ticks of the clock, estimate the second and tenth of a second at which the star is actually bisected by each of the five or seven wires in the eye-pieces, and to write down his results—all simultaneously. This is done daily at every observatory in the world.—Ed.]

DEVELOPMENT.

[1728]—"J. H." has hit the nail on the head, which I, too, for one, am always, in my own mind, hammering at. It is just the weak point, or link, or basis of Darwinism. The question, Shakespeare of science though he was, especially in temperament, so infinitely unconceited, not like Babbage and Wagner—he avoided, viz.: the cause of variation—even though we should grant his theory of development, from or after that. Miss Ballin, Miss Naden, and others assume development, "now in one way, now in another." But that is just begging the question. In a chest ouside my door there is a cat suckling her kittens, and a pigeon close to her pumping maize into her young. Now, I cannot say how monstrous it seems to suppose that cat descended from pigeon—or, if you must, from their common progenitor (he really is too convenient). Organic nature is due to the same cause as inorganic; predestined development of infinite reason, not the result of selected haphazard variation.

Commentator.

GESTURE-LANGUAGE.

[1729]—I have been much interested in Miss Ballin's series of articles on "Thought and Language," and I think that if the following fact, bearing on one branch of the subject, has not been quoted in your columns it deserves a corner, if one can be found for it. I came across it lately, while reading the first volume of Mr. John Morley's work on Diderot. That distinguished Frenchman appears to have been in the habit of trying a curious experiment at the theatre. He used to go to the highest part of the house, "thrust his fingers in his ears, and then, to the astonishment of his neighbours, watch the performance with the sharpest interest." He knew the words of most of the favourite plays by heart, and his object was to "isolate the gesture of the performers, and to enjoy and criticise that by itself. He kept his ears tightly stopped so long as the action and play went well with the words as he remembered them, and he only listened when some discord in gesture made him suppose that he had lost his place." Sometimes he would be asked for an explanation of his conduct, and he would tell his neighbours that he understood better when he *stopped his ears*. "I laughed within myself," says Diderot, "at the talk to which my oddity gave rise, and still more so at the symplicity of some young people, who also put their fingers into their ears to hear after my fashion, and were quite astonished that the plan did not succeed." In this, as Mr. Morley points out, Diderot was merely seeking a whimsical way of acting on his deep conviction that "language is a very poor, misleading, and utterly inadequate instrument for representing what it professes, and what we stupidly suppose it to represent. Rousseau had expressed the same kind of feeling when he said that definitions might be good things if only we did not employ words in making them."

Israel Abrahams.

BEAST LANGUAGE.

[1730]—Among all the speculations on this subject, I have never seen it suggested that possibly speech was attributed to animals by ancient savage tribes, for the simple reason that they have it. There is probably no animal that does not utter sometimes some sound identical with, or at least resembling, some word or words of a given dialect. The mere-pork was so named because he says those two words. The Katy-did is another example from the insect world. The cuckoo, again, says his two syllables as distinctly as any human being. (He is ever subject to alteration of voice like us—for I have heard one persist in enouncing "keowkoo" —as if suffering from cold.) The chough, again, says distinctly "chough," and nothing else (pronounced in throat and nose). The French, however, call it *chouette*. *En passant*, what absurd lines are—

> "The chough and crow to roost are gone,
> The owl sits on the tree."

At evening the crow certainly roosts, but the chough and owl fly and cry.

The common cock seems to say something, but imperfectly. He does not, to my ear, ever say "Cock-a-doodle-doo," but he generally (not always) crows in five syllables. I have been listening carefully to a long conversation kept up by three in my neighbourhood—treble, tenor, and bass, I may say. The big bass fellow says, "Cock-a-haw-a-haw-w-w-w!" as if he were very tired of life indeed. The tenor sings, "Cack-a-ha-a-ha!" which is his opinion on things in general. And a little chap (no doubt a bantam) insists it is "Kick-a-her-a-her-e-e!" But of doodle-doo I hear nothing. They have probably shelved that question.*

Once I was alone, and in a brown study. Suddenly it seemed to me that I had heard (not at that moment, but shortly before) a voice that said, "Quiero andar al correo." ("I want to go to the post," in Spanish.) I got quite uneasy; feared hallucination. I never had heard any one use that phrase, though, of course, I knew each word. In a minute or two, a cock crew hard by. There was the mystery! His observation was so like the above words that no parrot could have said them better—or, at least, so it seemed to me.

And it is probable that in early times fancy, through want of letters, was much more open to impressions of the kind. Let it, then, be supposed that the savage heard a beast or bird utter some word or phrase coinciding with his own speech, and it is by no means far-fetched to imagine, besides, that he would think many more might be added, *if the animal chose*.

Possibly, too, there were primitive dialects far more simple than any we know now. Surely the first, called *barbaroi*, must have used with great frequency and iteration the syllables, bar-bar-i-e. Their language abounded in labials and liquids. In Deut. ii. 20, we come on aborigines (extinct even when the history was written), called *Zamzummim*.† Evidently the Hebrews‡ heard nothing in their dialect but zum-zum-zum. It abounded in sibilants and liquids.

* I have just heard a thrush (to which I was not listening) conclude a phrase with *ἀνεβεβήκει* quite plainly. What legends might not be based on this!

† Zomzommim.

‡ Or Ammonites.

Now, a people using but a few sounds to express everything could hardly help believing that a cow, saying *moo moo*, was talking just as well almost as themselves.

In Chaucer we have, "I do not understand thy *leden*" i.e., Latin, addressed to a bird. The priest "pattering" (which comes from Pater), an unknown tongue, at the altar was not supposed more intelligent (*quâ* speaker) than the rook or owl.

Man, being a Simian, was, from his beginning, both observant and imitative. He would not be long in remarking that every race has a shibboleth, or password, of its own; and his imitative genius (if no other motive) would soon lead him, too, to frame a code of communication with his congeners. HALLYARDS.

GEORGE ELIOT.

[1731]—Your valued paper of May 8 contained a short account of a conversation of George Eliot with Mr. Lewes. I have never in my life read a line of this great thinker, although I have often heard the name mentioned. I greatly regret not to have done so, since the few lines you quote so entirely correspond with the line of thought such men as Haeckel, Buchner, Vogt, and other continental scientists now take up, that it proves to me afresh how great truths are brought to light almost at the same time, apparently spontaneously, in different countries, by people who hardly heard of one another's name. They seem, as it were, to come out of the "air" or the environments. The axiom of Descartes, "Cogito, ergo sum," always seemed to me to put the cart before the horse, since the development of every human being proves to a certainty that "existence" must precede consciousness or thought. "Sum, ergo cogito" appears to me the correct version, without going to the idea that we are "matter" only, unless, indeed, "thought" and consciousness are "one," perhaps the highest development of force, inherent, appertaining to certain combinations of matter. F. W. H.

GEORGE ELIOT ON OLD AGE.

[1732]—My mother is seventy-eight years of age; she has lost one bodily function after another till almost physically helpless; but her mind has shown no corresponding signs of decay, and the other morning she described her experiences from childhood to womanhood quite clearly and distinctly, and said that latterly things came back to her that she had forgotten for years; and added, "who could doubt the immortality of the soul on this account alone."

Is it not also a thing frequently noticed that when disease or decay has impaired the brain that at the last hour the mind has been able to assert its original power, and even force, in some great saying?

George Eliot's public utterances and teaching were ever of the highest, but no true friend would unearth either her private ideas or acts. The key to her character has yet to be found, and her remarks on old age, which you publish (apparently with approval) simply oppose a small number of unusual cases, which she says she met with, to the general experiences of mankind.

R. S. STANLEY.

[Whatever pyschological interest the facts related by Mr. Stanley may possess, I fail to see that his inferences from them have any warrant whatever. I am not quite seventy-eight yet myself, but, as a piece of personal experience, I may mention a vivid recollection of my grandmother's house, of a verandah in front of the drawing-room and dining-room, of a morning-room with stained-glass in one of its doors, and of a certain haunch of venison hung up by her cook, of which the black hoof and the flour dredged on it greatly attracted my infant attention. These reminiscences date from my third year; while matters which occurred when I was twenty-five are an utter and absolute blank to me!—ED.]

LETTERS RECEIVED AND SHORT ANSWERS.

F. W. H.—Admitting to the full the truth of what you say concerning priestcraft, the insertion of your letter must infallibly lead to an acrimonious and unprofitable discussion. Were I to admit it, rejoinders would come in dozens from priests of various denominations, which I could not in common fairness exclude. But we should assuredly find ourselves straightway plunged, head over ears, in a bitter theological controversy.—E. W. J. (1) I really cannot say, at this lapse of time, to what article or essay by Mr. Dallinger the remarks referred. (2) None of Mr. Proctor's lectures have been published, nor, in fact, well could be, inasmuch as they are extemporaneous. (3) I do not know how far Mr. Clodd has progressed with his "Essay on Evolution, Popularly Explained." (4) All I can say here is, that to give up the doctrine of Evolution would be akin to denying that it was daylight at a time when the sun was shining brilliantly in sky. No theological considerations whatever must ever be suffered to hamper the humble student of science, who is bound, in loyalty and devotion to Truth, to carry out his investigations (lead him whithersoever they may) with the sole end of arriving at it. *Fiat justitia, ruat cœlum.* Believe me that I appreciate your praise.—THOMAS AYERS. Received.—DR. LEWINS. John Bull is no doubt amenable to but too many of the charges that you formulate against him. Whether though he could or would gain any accession of sweetness and light in the way you suggest may legitimately be a question for difference of opinion.—CHARLES INMAN. That the sun is "revolving" through space presupposes that he is travelling round some centre. Of this we have no proof whatever; but it is practically certain that he, and of course our entire system, are travelling towards a point in Hercules, forming a triangle with μ^2 and λ in that constellation, at a rate of some 4·75 miles per second, or at a little more than one-quarter the rate of the earth's motion in her own orbit. In a universe in which every visible body is in motion it is in the last degree improbable that our own sun should be fixed in space.—DR. LEWINS. See p. 198 of Vol. VI. of KNOWLEDGE.—J. O. asks if Borneo offers any inducement for emigrants. Perhaps some reader familiar with Malaysia can furnish the information or refer our correspondent to a book on the subject.—M. B. Thanks for your kind attempt to minister to my amusement, but I had already received a copy, presumably from the editor. He favours me with them as they are published, but as, like the old woman in the parable, "I keep on never minding," I am driving him nearly crazy with rage. It seems impossible to conceive how any human being, not actually under restraint, can *buy* such irredeemable trash. If I might hazard a guess, I should say that the "Institute" must consist of its "Secretary" himself.—VOX. I know nothing of any special books from which students in the Science and Art Department are examined. A vicious system exists there of examining from certain cram-books, compiled especially by persons attached to the Department. Any one, however, who will master Dr. Carpenter's "Principles of Human Physiology" should be able to pass in an Honours examination anywhere. The best book on the composition of foods, &c., is Vol. III. of the "International Scientific Series" on "Foods," by the late Dr. Edward Smith.—MISS M. C. V. MACLEOD. Your communication was acknowledged at the time of its receipt. If you wish your MS. and pamphlets returned, kindly forward envelopes addressed and sufficiently stamped to the office. (I had written this reply when your second instalment of MS. arrived.) Do you—can you—expect that I can give up three pages and a half to the insertion of your exposition of your hypothesis? You quote from Lardner, in the most sublime disregard of the fact that he is about as much an *authority* on heat as Mrs. Trimmer! Try the Balloon Society again.—X. Y. Z. A very little algebra will enable the student to begin with the Differential Calculus. Try the book so often recently recommended here, Knox's "Differential Calculus for Beginners," published by Macmillan, and the book so strongly recommended by Colonel Campbell on p. 445, Homersham Cox's "Rudimentary Treatise on the Integral Calculus," which is No. 102 of "Webb's Series."—H. F. YOUNG points out that the Raphides in the common Lily of the Valley are interesting objects in the microscope and polarise well. He adds that the under cuticle of the leaves of this plant exhibits, when prepared and mounted in Canada Balsam, not only Raphides but stomata and spiral vessels.—GENL. HENRY P. BABBAGE. Charles Babbage received money from the Government for the purpose of developing certain inventions of his, and it matters less than nothing (as it seems to me) as far as our reviewer's argument is concerned, whether the money went into his pocket—which, of course, as a matter of fact, it did *not*—or into those of the artificers actually engaged in the construction of his engines. A huge sum was spent upon a machine of which no practical use has ever been made, and the Government, which unjustifiably expended public money upon what quâ Government, they had no concern whatever were left with an unfinished piece of mechanism on their hands. This is not the place to reiterate the unfortunate story of the uncompleted Difference Engines and Analytical Engines. If the expenditure of £17,000 of the national funds had had no other result than the publication of "Chapters on Intrigues of Science" in the work quoted by General Babbage, it would have been deplorable.—WM. H. DOYLE. Are you in earnest in your implied hope that I shall insert the hopeless rubbish so righteously refused by the Shanghai *Evening Mercury*?—H. D. BERRIDGE. They may be obtained of the Electrical Power Storage Company, 4, Great Winchester-street, E.C., or of Messrs. Elwell, Parker, & Co., Wolverhampton.

ON THE CHANGES PRODUCED BY MAGNETISATION IN THE LENGTH OF RODS OF IRON, STEEL, AND NICKEL.

BY SHELFORD BIDWELL, M.A., LL.B.

Read at the Meeting of the Royal Society, April 23, 1885.

THE earliest systematic experiments on the effects produced by magnetisation upon the length of iron and steel bars are those of Joule, an account of which is published in the *Phil. Mag.* of 1847. Joule's experiments have many times been repeated, and his general results confirmed. In particular, Prof. A. M. Mayer carried out a series of very careful observations with apparatus of elaborate construction and great delicacy. The conclusions at which he arrived were in accord with those of Joule, so far as regards iron: in the case of steel there was some apparent discrepancy, which, however, might to a great extent be accounted for by differences in the quality of the metal used, and in the manner of conducting the experiments. In 1882 Prof. Barrett published in *Nature* an account of some experiments which he had made, not only on iron but also on bars of nickel and cobalt, with the view of ascertaining the effect of magnetisation upon their length.

The knowledge on the subject up to the present time may be summarised as follows:—

1. Magnetisation causes in iron bars an elongation, the amount of which varies up to a certain point as the square of the magnetising force. When the saturation point is approached the elongation is less than this law would require. The effect is greater in proportion to the softness of the metal.

2. When a rod or wire of iron is stretched by a weight the elongating effect of magnetisation is diminished; and if the ratio of the weight to the section of the wire exceeds a certain limit, magnetisation causes retraction instead of elongation.

3. Soft steel behaves like iron, but the elongation for a given magnetising force is smaller (Joule). Hard steel is slightly elongated, both when the magnetising current is made and when it is interrupted, provided that the strength of the successive currents is gradually increased (Joule). The first application of the magnetising force causes elongation of a steel bar if it is tempered blue, and retraction if it is tempered yellow: subsequent applications of the *same* external magnetising force cause temporary retraction, whether the temper of the steel is blue or yellow (Mayer).

4. The length of a nickel bar is diminished by magnetisation, the maximum retraction being twice as great as the maximum elongation of iron (Barrett).

In order that the results of Joule and Mayer might be comparable with those obtained by the author, he made an attempt to estimate the magnetising forces with which they worked. From data contained in their paper, it was calculated that the strongest magnetising force used by Joule was about 126 units, while the strongest used by Mayer did not on the highest probable estimate exceed 118 units. In the author's experiments, the magnetising force was carried up to about 312 units. The metal rods, too, were much smaller than any which had been before used for the purpose, ranging in diameter from 1·40 to 6·25 mm. Their length was in every case 100 mm., and the apparatus was capable of measuring with tolerable certainty an elongation or retraction equal to a ten-millionth part of this length.

By using thinner iron rods and greater magnetising forces than those previously employed, the following curious and interesting fact was established. If the magnetisation be carried beyond a certain critical point, the consequent elongation, instead of remaining stationary at a maximum, becomes diminished, the diminution increasing with the magnetising force. If the force is sufficiently increased, a point is arrived at where the original length of the rod is totally unaffected by magnetisation; and if the magnetisation be carried still further, the original length of the rod will be reduced. It also appeared that the position of the critical point in steel depended in a very remarkable manner upon the hardness or temper of the metal; considerable light is thus thrown on the apparently anomalous results obtained by Joule and by Mayer. Further experiments disclosed strong reason for believing that the value of the critical magnetising force in a thin iron rod was greatly reduced by stretching; this would explain the fact that Joule obtained opposite effects with stretched and unstretched wires.

By ascertaining the relative values of the temporary moments induced by gradually-increasing external magnetising forces, an attempt was made to connect the point of maximum elongation with a definite phase of the magnetisation of the several rods in which the elongation has been observed.

Though more experiments must be made before it is possible to generalise from them with perfect safety, the results so far obtained by the author indicate the laws given below. The elongations and magnetisations referred to are temporary only; before the beginning of an experiment, the rod was permanently magnetised by passing through the magnetising coil a current equal to the strongest subsequently used. In iron the greatest elongation due to permanent magnetisation was generally found to be about one-third of the total elongation, while in nickel the permanent retraction amounted only to about one twenty-fifth part of the whole.

I. IRON.

1. The length of an iron rod is increased by magnetisation up to a certain critical value of the magnetising force, when a maximum elongation is reached.

2. If the critical value of the magnetising force is exceeded, the elongation is diminished until with a sufficiently powerful magnetising force the original length of the rod is unaffected, and if the force is still further increased the rod undergoes retraction. Shortly after the critical point is passed, the elongation diminishes in proportion as the magnetising force increases. The greatest actual retraction hitherto observed was equal to about half the maximum elongation, but there was no indication of a limit, and a stronger magnetising force would have produced further retraction.

3. The value of the external magnetising force corresponding to maximum elongation is for a given rod, approximately equal to twice its value at the "turning point."

Definition.—The turning-point in the magnetisation of an iron bar is reached when the temporary moment begins to increase less rapidly than the external magnetising force.

4. The external force corresponding to the point of maximum elongation increases (when the quality of the iron is the same) with the diameter of the rod. So also does its value at the turning-point.

5. The amount of the maximum elongation appears to vary inversely as the square root of the diameter of the rod, when the quality of the iron is the same.

6. The turning-point, and therefore presumably the point of maximum elongation, occurs with a smaller magnetising force when the rod is stretched than when it is unstretched.

II. STEEL.

7. In soft steel magnetisation produces elongation, which, as in the case of iron, increases up to a certain value of the magnetising force, and afterwards diminishes. The maximum elongation is less than in iron, and the rate of diminution after the maximum is passed is also less.

8. The critical value of the magnetising force for a steel rod diminishes with increasing hardness up to a certain point, corresponding to a yellow temper; after which it increases, and with very hard steel becomes very high. There is, therefore, a critical degree of hardness for which the critical magnetising force is a minimum; in steel of a yellow temper the value of the critical magnetising force is lower than in steel which is either softer or harder.

9. In soft steel a strong magnetising force subsequently diminished may cause a greater temporary elongation than the diminished force is capable of producing if applied in the first place.

10. A temporary elongation when once produced in soft steel may be maintained by a magnetising force which is itself too small to originate any perceptible elongation.

III. NICKEL.

11. Nickel continues to retract with magnetising forces far exceeding those which produce the maximum elongation of iron. The greatest observed retraction of nickel is more than three times the maximum observed elongation of iron, and the limit has not yet been reached.

12. A nickel wire stretched by a weight undergoes retraction when magnetised.

Our Whist Column.

BY FIVE OF CLUBS.

THIS game illustrates the necessity of playing to the score, and not trying for more tricks than are wanted. *Z* starts out rightly with the idea of making a great game; but so soon as his partner has won the third trick he sees that as *Y*-*Z* are four by honours the odd trick only is wanted to win the game. Moreover, the odd trick is essential to save the game. Now, to make the odd

trick, *Y-Z* want two tricks besides the certain trick given by the winning trump. *Z* adopts the only possible way of making the odd trick. Of course, to have played otherwise would have been bad play; but how often do we see a game thrown away in such a position through undue haste to prevent the enemy from making his last trump by ruffing; or, if the Scylla of that mistake is escaped, then by falling into the Charybdis of ruffing the enemy's established suit too quickly?

THE HANDS.

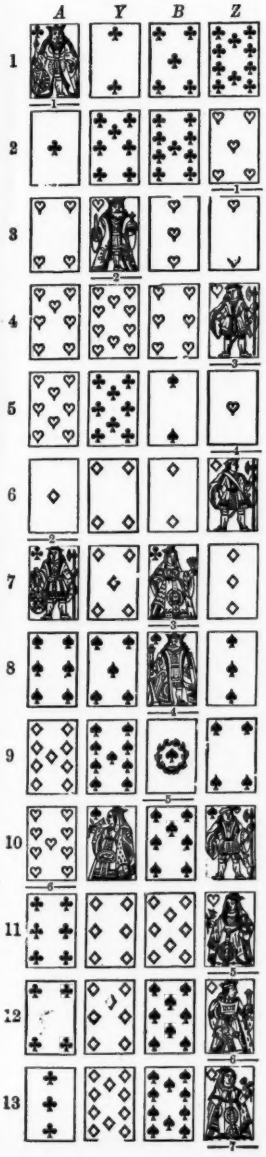
B { H. 6, 3. S. A, K, 10, 8, 7, 2. C. Q, 9, 5. D. 8, 2. }

Y { H. K, 10. C. 8, 7, 2. S. Q, 9, 5. D. 10, 7, 6, 5, 4. }

B
Tr. H. 2.
Y Z
A-B, 4.
Y-Z, 0.
A leads.

2, 5, Kn, Q, A. H. 10. C. 3, 4, Kn, S. 3, Kn, Q, K. D. } *Z*

A { H. 9, 8, 7, 4. S. 6. C. A, K, Kn, 6, 4, 3. D. A, 9. }



THE PLAY.

Card underlined takes the trick and card next below leads next.

1. *A* leads the right card from his long suit.

2. *Z* shows by trumping with the Five, and leading the Two, that he holds three more. *Y-Z* hold four by honours, and need only the odd trick to win the game.

3-4. From the return of Ten, *Z* learns that *Y* cannot have more than one trump left, at the utmost: for Ten is the best trump outside *Z*'s hand, and must either, therefore, be the best of two or *Y*'s only trump left (with two more he would have led the lowest).

5. *B* falls here into a fatal blunder. He probably supposed that *Z* would proceed to extract *A*'s last trump, in which case *B*—let us hope—would have discarded the Queen of Clubs, his holding which was the cause of *A-B*'s destruction. But

6. *Z* is far too wide awake. He sees the meaning of his partner's discard. If the Queen of Clubs had been with *Y*, Queen and eight would have been the Major Tenace, and *Y* would assuredly not have parted with that hold over *A*'s long suit. *Z* sees that if he goes on with trumps, and *B* gets out of *A*'s way, there is danger (*certainly*, if *A* has any re-entering card) that *A* will make four tricks in Clubs and win. He therefore clears his strong Diamond suit at once, finding *A* with the dreaded but now innocuous re-entering card in that very suit.

7. But *B*'s Queen blocks the way. *Z*, of course, refrains from ruffing, which would ruin everything.

8 and 9. *B* makes two tricks in Spades, and

10. *A* makes his little trump. But it avails nothing; for

11, 12, and 13. *Y-Z* make three more tricks, giving them the odd trick and the game.

If *B* had played properly at trick 5 — discarding the Club Queen. The game would have proceeded as follows:—

	A.	*Y.*	*B.*	*Z.*
5.	H 8	C 8	C Q	H A
6.	D A	D 4	D 2	D Kn
7.	C Kn	D 5	S 2	S 3
8.	C 6	D 6	D 8	S 4
9.	C 4	D 7	S 7	D 3
10.	C 3	S 5	S 8	S Kn
11.	S 6	S 9	S K	H Q
12.	H 8	D 10	S 10	D K
13.	D 9	S Q	S A	D Q

6. *Z* will gain nothing by drawing out *A*'s last trump, as the third form of the game shows, in which the same result is obtained at the end of trick 6 as if *Z* had drawn the last trump.

7, 8, 9, 10. *Z* can gain nothing by ruffing. It would not be sound play to try the experiment, though *A* *might* have two Diamonds. As the cards lie *Z* would make his trump and his Diamond King; then *A* would ruff the Queen, win three Club tricks, and, leading Spade, *B* would win the last trick.

11, 12, 13. *A-B* make the odd trick and win a treble too as tricks count before honours. As the game made the rubber, *B*'s mistake cost *A-B* six points.

If, reverting to the original game, *Z* had drawn *A*'s last trump, the game would have proceeded as follows:—

	A.	*Y.*	*B.*	*Z.*
5.	H 8	C 8	S 2	H A
6.	H 9	D 4	C Q	H Q
7.	D A	D 5	D 2	D Kn
8.	C Kn	D 6	S 2	S 3
9.	C 6	D 7	D 8	S 4
10.	C 4	D 10	S 7	D 3
11.	C 3	S 5	S 8	S Kn
12.	S 6	S 9	S K	D K
13.	D 9	S Q	S A	D Q

6. *B*, of course, can still lose the game for self and partner by holding on to his winning Club.

7, 8, 9, &c. *A-B* win two cards. *Y-Z* make the odd trick if *B* holds up the Club Q at trick 6.

AT the meeting of the Geological Society held on May 13, 1885, Professor T. G. Bonney, D.Sc. LL.D., F.R.S. (President), in the chair, a paper was read on the "Evidence of the Action of Land-ice at Great Crosby, Lancashire," by T. Mellard Reade, Esq., F.R.S. The author pointed out that the Triassic rocks under the low-level boulder-clay in the neighbourhood of Liverpool, where they are not smoothed and striated, are usually broken up into rubble and red sand, forming a bed of variable thickness occasionally consolidated into a breccia. This deposit he had in former papers attributed to the action of land-ice. At Mowbrey brick-and-tile works, Great Crosby, is a section of Keuper marls, the only one existing for many miles round. The marls are overlain by low-level boulder-clay of the usual type, and between it and the marl is a deposit from 3 to 4 ft. thick, which at first sight is not readily distinguishable from the marls, but which a careful examination of the excavations from time to time as they progressed, showed to be a distinct bed. In this bed, lying at all angles, were found large blocks of sandstone, some of which were grooved and striated in an unmistakable manner. The matrix in which they were imbedded was of the same constitution as the marl, and evidently formed out of it, showing in places strong evidences of contortion and kneading up. The sandstone blocks belonged to the Keuper formation, and some of them were very similar to bands intercalated in the marls near the bottom of the excavation. No erratic pebbles or boulders of any sort were found in this kneaded-up marl, whereas the low-level boulder-clay is full of them. The author considered that the only feasible explanation of the phenomenon was that the marl had been worked up into a grey clay by the passage over it of land ice, which had broken off the sandstone-bands at their outcrops, forcing the blocks into the disturbed or worked-up marl. These outcrops, concealed by a mantle of low-level boulder-clay, must be to the northward, and therefore the blocks have travelled in the same direction approximately as the track of the striations on the neighbouring rocks. In conclusion, he contended that all the evidence points to the fact before insisted upon, that the intensest period of cold preceded the deposition of the low-level boulder-clay, which is clearly a marine deposit.

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (Knowledge *being a popular magazine*) *than is accorded by the most excellent trade journals.*

THE RED CROSS POCKET AMBULANCE.

Under this title Messrs. Russell & Everett have brought out, at a very trivial cost indeed, a pocket case which the traveller can scarcely fail, at one time or another, to find useful, and to the contents of which he may even on an emergency be indebted for his life. Its outside measurement is 6 in. by 3¼ in. by 1 in. Hence it will be seen that "pocket" ambulance is no misnomer. It contains the triangular bandage (the use of which is taught by the St. John's Ambulance Association), a box of antiseptic ointment, compress to stop bleeding, tape, pins, waxed thread, &c. The value of so very portable a means of immediately dressing wounds, and providing for accidents pending the doctor's arrival to the cyclist, the ordinary tourist, the Volunteer, or the athlete, scarcely needs insisting on.

AN IMPROVED CASTOR.

(Patent 2,447. 1884.)—Mr. Sprague, of 20, Parliament-street, Westminster, has invented a form of castor in which a solid or hollow ball of iron or steel works in a socket of brass or other material, from which it is prevented from falling out by the attraction of a steel horseshoe magnet, the poles of which are put through holes in the cup, not more than one-half of the ball being covered by the cup. The castor is attached by means of a flange, a mortise being made to receive the magnet. The magnet may also be placed in a horizontal position, and in some cases its ends may be expanded in such a manner that a separate cup may be dispensed with.

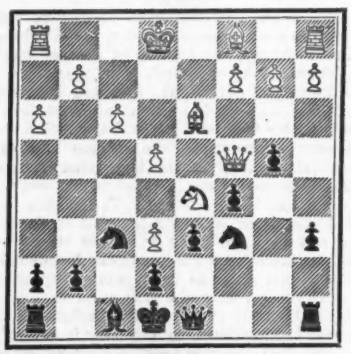
Our Chess Column.

By Mephisto.

An interesting position of a game played recently at the City of London Chess Club. Black having given the odds of Pawn and move to White.

B. G. Laws.

White.



Black.

J. Gunsberg.

It will be seen that the White P on K6 terribly cramps Black's game. Had White played P to QR3 he would have provided against Black's Kt to R4. White would also thereby open up his Rook's file and maintain his strong position. Instead of this line of play, which would probably have led to victory, Mr. Laws was affected by the chance of making a combination—a mode of play particularly agreeable to prodigious problem composers—the result being that Black, although temporarily losing a Pawn, issued from the *surprise* with a more hopeful position, which enabled him to draw. Moral—In match play, mistrust combinations, however alluring and tempting, unless they yield a distinct advantage. White's play was, however, both deep and pretty. He played—

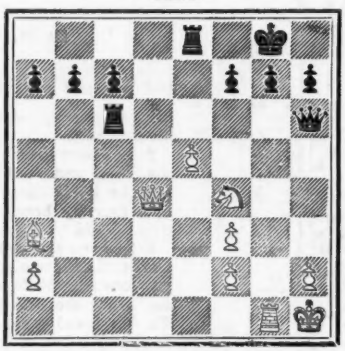
P to B4	Kt to QR4
Q to Kt5 (ch) !	P × Q
B × P (ch)	Kt to Q2
B × Kt (ch)	Q × B
P × Q (ch)	K to Q sq.
P to B5	Kt to B3
B to K3	Kt to K4
P to QKt3	Kt × P
P to KKt4	Kt to B3!

Best. It forced White to exchange Kt's, and Black succeeded in blocking White's Pawns, forcing a draw.

Position after Black's 29th move, R to K sq., in a game played some time ago between two provincial amateurs.

C. Pardoe.

Black.



White.

O. H. Labone.

The game concluded as follows :—

30. P to K6	P × P

Forced. If Black plays P to B3, White wins by 31. Q to Q7, R to R sq. 32. Q to B7 (ch), K to R sq. 33. B to B8, &c.

31. Kt to R5!	P to K4
32. Q to Q5 (ch)	K to R sq.
33. Kt × P	R to KKt sq.
34. Q × R (ch)	K × Q
35. Kt to B5 (ch)	Q to Kt3
36. Kt to K7 (ch)	K to B2
37. R × Q	

White's play is both forcible and elegant. The last move is particularly correct, and stronger than 37. Kt × Q, for after P × Kt, Black has just that little amount of fight left which in some positions make it so difficult to realise the advantage of forces. This move at once lessons the hope of playing for a draw. Black ought, however, to have accepted the exchanges by replying with R × R. 38. Kt × R, P × Kt. 39. K to Kt2, K to K3. 40. K to B sq., K to Q4. 41. K to K2, P to B4, and attempt to advance the P's on the Q side.

37.	R to B6

In the hope of being able to gain the piece, and avoid exchanging Rooks.

38. R to B6 (ch)	

An elegant device. If K × R, 39. Kt to Q5 (ch) wins.

38.	K to Kt2
39. B to Kt2	Resigns.

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